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INTRODUCTORY NOTE

It has been deemed advisable to present in this number of the RECORD several papers which are fairly typical of the activity in the Practicum of the Department of Secondary Education. Each one of the students in the practicum considers a problem of moderate compass. It may stand in relation either to matters of practical instruction in the high school, or to the theory of presentation in a given subject, or else may involve a study and analysis of existing educational conditions.

The papers selected for the present number bear upon the teaching of history, of mathematics and of Latin.

Miss Stevens's paper outlines the groundwork of a first-year course in history based upon studies in anthropology, which may be made preliminary to the general high-school history work. It suggests interpretation of fundamental institutions of which pupils usually entertain unsatisfactory and vague conceptions. It has been tested in high-school work, and has proved valuable to the student body.

Of the two mathematical papers, the one of Mr. Millis deals with a question that is just now under constant discussion; the value of the paper lies in the collection from various sources of real problems in geometry; no attempt beyond the drawing of the figures is made to suggest the mathematical solution, which is, however, reasonably obvious in most of the problems.

Miss Brookman's paper discusses the defects of first-year high-school mathematics, both in the character of the teaching and the scope of the work, and attempts to suggest remedies by improvement in teachers and text-books.

The paper of Mr. Inglis on correlation in foreign language work indicates a trend in teaching which has proved very effective in German schools, and which American teachers of good linguistic training can employ to the definite advantage of their classes.

In all these papers no attempt at special editing has been undertaken; they are reproduced as they were presented for class discussion; it seemed best to afford by their unconventional form an insight into the spirit of the practicum.

It may not be out of place to append a list of some of the other themes that have recently been discussed in this practicum; it will appear from how many points of view contributions to the teaching problems of the high school may be made:

The didactic value of the short story in the English teaching of the high school.
The proper material of a beginner's Latin book.
Problems in the teaching of high-school physics.
Does the high school permit individualization of the pupils? To what extent is it desirable or practicable?
The École Normale Superieure—its history—the present situation.
Methods of controlling and reducing home work.
The historical development of the secondary school curriculum.
The curriculum of the commercial high school with a consideration of its economic and social background.
The problem of the conditioned student in college.
The artistic interpretation of literature.
The arguments concerning the value of the study of mathematics.
On sight-reading in Latin.
Discipline in the high school.
The problem of moral instruction in the high school.

JULIUS SACHS.

PRIMITIVE HISTORY

A Plea for its Place in the Curriculum of the High School

By Romiett Stevens

Only a comparatively few years ago the subject-matter of history as presented to the youth in our schools began with the migration into the peninsula of Greece of hordes of barbarians. The impression made was that there poured down from the regions of the Ural Mountains a living stream that quickly immersed the whole of Greece, and its neighboring islands, and established there a nation and a culture wonderfully developed. Even such an excellent text as Myer's History of Greece begins with this introductory paragraph:

"HELLAS—The ancient people whom we called Greeks called themselves Hellenes and their land Hellas. But this term 'Hellas' as used by the ancient Greeks embraced much more than modern Greece. 'Wherever were Hellenes there was Hellas.' Thus the name included not only Greece proper and the islands of the adjoining seas, but also the Hellenic cities in Asia Minor, in Southern Italy and in Sicily, besides many other Grecian settlements scattered up and down the Mediterranean and along the shores of the Hellespont, the Propontis and the Euxine.

"Yet Greece proper was the real home land of the Hellenes, the land in which they believed themselves to be indigenous, and which was the actual center of Greek life and culture."

Some writers attempt a little more in the way of visualizing an early stage of culture in Greece. Botsford, for example, gives the following picture:

"In the fertile valleys the villagers dug the ground with a sharp stick and raised wheat, barley, flax and some garden vegetables. But they owned no farms, as they had not yet learned that land was valuable; they could get all they needed by fighting for it, and they had no thought of staying long in one place. Every man went armed to protect his life and his property. One village was continually fighting with another, and the

people who had settled homes lived in constant fear of attack from fresh invaders. The villagers, therefore, built no good houses, planted no orchards or vineyards, but stood ever ready to gather their scanty wealth into ox-carts and to join their tribe in search of more fertile fields or homes less exposed to the enemy. Thus the Greeks kept moving about and fighting among themselves for many years, perhaps for centuries. The time during which they lived in tribes and villages in this unsettled manner we may term the Tribal Age."

Children in our high schools to-day find in their texts a few chapters prefixed to the content of Greek history, giving brief sketches of the civilization of the Egyptians, Chaldæans, Hebrews, Assyrians and Persians, in each case, however, as a well-developed nation. Quoting Botsford again, the Egyptians are introduced in the following lines:

"Here in the remote past lived a people whom we class with the other North Africans as Hamites,—one of the three main branches of the Caucasian or white race. Whence the Egyptian Hamites came we do not know. We can say, however, that as early as 4000 B. C. they were already acquainted with many of the arts; they had, too, a well-developed religion, society and state; they must have started on the road to this high civilization at least four or five thousand years earlier."

Of the Phœnicians he writes:

"As the commerce of the Phœnicians was already extensive in the fifteenth century B.C., we may suppose that hundreds of years earlier they began their voyages in the Mediterranean."

A few historians are beginning to give some attention to the steps leading to the development of the stages of culture represented by these nations—in other words to prehistoric conditions, but the best that can be done within the covers of a text in ancient history is to give a few generalities regarding the existence of life upon the earth prior to the beginnings of history proper, and to indicate some of the many economic difficulties that were overcome in the life history of each race and people before it was able to make conscious and systematic record of its activities as a nation.

My purpose in these pages is not in reality to pick a quarrel

with the content of Greek or Egyptian history as presented, but to urge the value of the *prehistoric* introduction as a basis for the structure of history in order to remove the oft-given impression that nations sprang into being, all-powerful and all-wise, like Thebes from the dragon's teeth planted by Cadmus.

The sources for such a study of life previous to the time when peoples began to chronicle events systematically, are to be found in the subject-matter of the sciences of archæology and ethnology. Primitive man has left records of his history, however unconsciously, in the shifting sands of every continent, and these records of bone and stone are now being brought to light by the archæologists, and translated into human history by the ethnologists. The translation into human history is very greatly assisted by the ethnological studies of the primitive folk living upon the earth's surface to-day. It is possible to find people still living in primitive stages of development. For example, the natives of Central Australia, the Bushmen of Africa and the desert Indians of Nevada, while not possessing wholly identical elements of economic and thought life, still have enough to class them as representing very low stages of culture. Generally speaking, they have no settled homes, they do not practise agriculture, they wander from place to place in search of food, following the migrations of game; their weapons are of rough stone and bone. Although alike in these fundamental economic conditions, they differ in others. They in turn bear some points of resemblance to what we know of the earliest Greeks and Romans; they differ in others: they present some points of similarity with the Eskimo, the Patagonians, the Ainu of Japan, the Tungus of Siberia; they differ in other phases of culture. We do not expect to find a uniform development for prehistoric peoples any more than for historic races.

It would simplify matters greatly if we could establish an evolutionary theory for prehistoric life, and state that for all races there was once a cave-dwelling stage, and then the hut of branches or stones, and that the discovery of the bow and arrow followed the use of the spear, that iron followed the knowledge of copper, that pottery was founded upon basketry, etc., etc.,

but since no scientific studies seem to warrant such a presentation, we must pursue the study consistently with the best methods in history—through the study of facts—as far as they can be ascertained. Ethnology, although a comparatively recent science, already furnishes enough of fact to lay an ample foundation for the study of history, and that is the definite purpose in its presentation.

With all due allowance for the present incompleteness of the science of racial history, and for the fact that some statements put forth by one body of anthropologists in one year are sometimes contradicted or modified a year later by another body, the general facts of man's existence in the different stages of culture from savagery to civilization are now indisputably established. That man did not spring into existence in full possession of culture, material and immaterial, that his history does not begin with the building of pyramids or formation of governments, that his ancestors have not always been Latin, Slav or Teuton, are facts which no longer require defense. Then again, that there was a time when man first began to gain control over the wild beasts of the forest, and subject them to his bidding; that there was a time when he had no artificial dwellings and first began to fashion them; that there was a time when electricity, coal, gas, matches and flint were unknown, that he had to get fire to warm him from the fires kindled by nature; that there was a time when primitive man did not know what made the sun give comfort and warmth at one time, withholding them at another, and that he first began to reason about such phenomena, so vital to his well-being, are all facts that one no longer questions.

As all civilizations have sprung from activities of mankind just as fundamental as these, they should certainly be given a place basal to the study of history. It seems natural and consistent to first present the primitive aspects of the subject to the student in opening up for him the vast field of history, the pursuance of which ought, if rightly conceived, to contribute more to his own cultural development than almost any other subject in the whole range of the school curriculum.

Furthermore, this is the logical method of procedure. If it is logical to begin with the history of Egypt and Greece, proceeding thence to Rome, Central Europe, England and America, it certainly would be logical to base the study upon an ethnic foundation. We sometimes admit that in the history of Greece we lay emphasis upon the development of the State, in Rome upon the development of Law, in the Middle Ages upon the development of Institutions. The beginnings of all institutions are to be found in primitive life, and they cannot be fully understood except in the light of the fundamental operations in primitive life.

If it is logical to begin with Egypt and Greece, in order that the sequence of discovery and development may be maintained, then it is equally logical to begin even nearer the beginning, wherever that is possible. Twenty-five years ago it was not possible to antedate history in any way because of the extreme youth of the science of ethnology. At present there is no such barrier, and it seems as if the time had come for ethnology to yield its wisdom for the fundamental facts regarding life upon the globe. To be sure, the chronological sequence cannot be maintained, but that is an insignificant factor compared with the sociological and economic truths which can be established.

As it is natural and logical to offer these introductory phases of life history, I offer as a third argument that primitive history is necessary for the unification of the whole subject. As these experiences of primitive men were basal to all nationalities and fundamental in the life histories of all peoples, the study of them should precede the differentiation of nations. Primitive history may be likened to the trunk of the tree of civilization, deep-rooted in nature's soil, and the different races and nations of the earth to its branches, large and small. Through this same trunk there has passed all the life blood that has nurtured the branches through all time. There could be no unity, there could be no life, without the trunk.

In the fourth place, racial history bears a direct relation to present life—to every existing condition of our civilization,—and therefore it has a more vital interest to us than facts of history that do not manifest this connection. In fact, very many of the

conditions of our present civilization cannot be understood except in the light of the fundamental operations which governed life in its primitive stages. For example, the differentiation of the labors of men and women finds one explanation in the first hearth fires of the savages when it became necessary for some member of the family to constantly care for the fire that had been procured with such great difficulty, and so the duty fell to the one less well adapted by nature for the more vigorous life of the hunt.

The position of our common domestic animals in their relations to the human family, although maintained for countless generations, cannot be thoroughly understood except through a knowledge of the whole widening circle of animal life from the wild state of freedom to the present one of obedience to man's control.

Nature's food-stuffs and the medicinal properties of herbs have each a history older than the pyramids. Government cannot be understood without some knowledge of clan organization, agriculture without the digging stick, nor religion without the animistic beliefs of savages.

The fifth and last point in the defense of primitive history is that it has a broad vantage ground. It is not exclusively political in its development. It bases the study of history on life—the social, industrial, esthetic and religious, *as well as* the political features. Our own present high estate has a broader significance to-day than the purely political. The ***human family*** is a nobler subject for study than records of battles and chronological lists of heroes famous only for military prowess.

If I may be allowed a digression here, I would like to point to a few signs of the times which indicate that the backbone of the history teaching that is purely political is broken already. A comparison of text-books, old and new, has been illuminating, and nothing better demonstrates the change in front than the authors' prefaces stating the purposes of their books. A First History of Greece published by Appleton in 1884 has this introduction: "The history of Grece is, in general, very perplexing to children, from its involving events connected with a number of small states, the names of which are for the most part new to

them. Even to read it with a map does not materially lessen the difficulty; for children, especially girls, rarely know much of ancient geography, and whilst they are laboriously searching for the unknown places, the thread of the history is interrupted, and their attention perhaps irrevocably distracted. With the view to lessening this evil, a short chapter has been prefixed to the following history, containing the names of the Grecian states, and the chief places mentioned as connected with them. And it may perhaps be found that, by giving children a lesson in the ancient geography of Greece, before they begin to study its history, and making them as well acquainted with the divisions of the country as they are with those of England, they may be better able to comprehend what otherwise might appear only a confused account of petty wars, uninteresting and unimportant."

Turning from this book, which promises nothing better than an historical diet of skimmed milk, to Professor Botsford's introduction, is like coming upon a Christmas feast. He says: "The ancient Greeks were the most gifted race the world has known,—a people with whose achievements in government and law, in literature, art and science, every intelligent person ought to be acquainted. Not only is the story of Greece in itself interesting and attractive, but the thoughts and deeds of her great men are treasures preserved in history for the enrichment of our own lives. . . . Though the Greeks were constantly at war, we must not lay too much stress on the details of their campaigns and battles. It is far more profitable to learn the character and achievements of the great men, whatever their field of activity, to follow the development of the social and political life, and to enter into the spirit of the civilization."

Professor Robinson in the preface to his History of Western Europe lays emphasis in the same place. He speaks of the development of European culture as a problem in *proportion*—and again "the scope of the work has been broadened so that not only the political, but also the economic, intellectual and artistic achievements of the past form an integral part of the narrative."

A candidate for doctor of philosophy in political history took the examination for history teachers given by the Normal

College in the spring of 1906. She said with much animus that the questions were all upon *social* and *industrial* phases of history, and that practically her work for the doctorate had counted for nothing. I mention this not to depreciate the courses in political history, but just to show the inclination of the pendulum towards phases of history other than political for the education of youth in our schools.

Methods of Presenting the Subject

The first year of a high-school course would be the best for the work in primitive history, but it could easily be adapted to the eighth grade. The content could be presented in several different ways, of which the following two seem the most practical.

First Method: A study of primitive life by continents—a broad geographical and ethnological survey of life, past and present. The continent of Africa alone would furnish almost every type of development. In point of fact, care would have to be used in selecting and simplifying the subject-matter presented to pupils in order that clear and direct impressions could be given. The continent of Eurasia would be approached through ethnological studies that have been made in recent years. North America, South America and Oceania present different and in some ways simpler problems of this ethnological survey. This method would offer opportunity for geographers and historians to work upon a common basis.

Second Method: This would include a history of the people, approached through their industries and institutions. The history of food-getting, fire-making, cooking, shelter, dress, travel and transportation, suggests some of the phases of the subject which would embody the life of the people themselves. As hunger has always and everywhere been one of the most potent stimuli to activity, its gratification upon the part of early peoples called into being a large number of activities connected with agriculture in its simplest phases, domestication, fire-making, transportation, etc. The history of these activities of food-getting,

with the geographical distribution of the same, would easily constitute the work of the first half of the year.

I will suggest briefly under a few headings the possible division of the subject by this method:

I. Food-getting. The study of foods would comprise something of the history of typical fruits, vegetables and cereals, as well as that of animal food,—a history as dignified and as diversified as that of the peoples subsisting upon these foods supplied by nature.

II. Tools used in Food-getting. The methods of getting food, both animal and vegetable, would involve the ingenuity and inventiveness of different peoples. The rough stone implements of the hunt found in Australia, the perfected use of metal in parts of Africa, the distribution of the digging stick where agriculture has its crude beginnings, the skilfully made bow and arrow in one region, and its total absence in others, the cleverly invented throwing stick, etc., etc., are some of the studies that would be presented in order to put boys and girls into possession of an appreciation for the industrial conquests of primitive and historic peoples, and their own industrial inheritances.

III. Fire-making. Fire-making is an especially interesting study in that it touches both the economic and the thought-life of people. In the latter connection there are the myths offering explanation for the mysteries of nature-kindled fires, an introduction to the immaterial life of a race. Upon the material side the subject may be divided into special heads such as these:

A. Nature-kindled fires.
B. Means of preserving fire.
C. Ways of making fire artificially—fire-plow, fire-drill, fire-saw, flint and steel, matches, gas and electricity (if one wishes to bring the subject down to modern times).
D. Fire as a weapon.
E. Fire as a factor in making a permanent home.
F. Fire for cooking food.

IV. The Domestication of Animals. The study of the

domestication of animals suggests treatment somewhat like this:

A. Theories regarding domestication.

B. Place of the different animals in the economy of the family, (a) as food, (b) as co-laborers with men and women.

C. Life history of the dog, cat, pig, horse, cow, and barnyard fowl, treated somewhat like that of plants, in adaptation to the service of man, influence upon the life of man and distribution over the earth's surface.

V. Basketry and Pottery. These industries could be presented here in connection with food-getting because they were probably called into being through the need of primitive woman for some receptacles for the carrying and storing of food. The study is an interesting one in itself because of the individuality of different groups of people manifested in the technique and in the decoration of their baskets and pottery. It may also be made to show something of the artistic conception of people, and of the prominence of symbolism in certain places.

VI. Materials used for Clothing and the Methods of preparing them. The adaptability of nature's stuffs to clothing may be presented thus:

A. Animal products—(a) skins, (b) silk, (c) wool.

B. Vegetable products—(a) cotton, (b) flax, (c) cedar, (d) pulp and fiber, tapa.

C. Spinning and weaving.

D. Sewing.

VII. Dress and Ornamentation. After a consideration of the materials for clothing, the subject that would naturally follow would be that of dress and ornamentation, laying stress upon the place of dress in primitive life—(a) for protection, (b) for ornamentation, and upon the persistence in modern civilization of primitive features of love for ornamentation.

VIII. The Dwelling. Next there may be presented types of dwellings as they seem to meet the needs of primitive folk

distributed over the earth's surface, revealing the ingenuity and individuality manifested in construction.

A. Tree dwellings, cave dwellings, wind-breaks, snow huts of Eskimo, pile-dwellings, huts, houses.

B. Primitive furnishings—origin of the chair, table, bed, stove.

IX. Travel and Transportation. A study of travel and transportation would have its first connection with the history of domestication of animals, and lead on to modern methods of transportation and the use of vehicles for land and ocean travel. Pupils cannot fail to have a higher estimate of the Eskimo of North America after they have studied the marked ingenuity of the Eskimo in the construction of his kayak and his marvelous skill in manipulating it upon the Arctic seas. The birch-bark canoe of some tribes of American Indians, the South Sea canoe with its outriggers, the dog-sled of the Eskimo, all contribute their share toward giving boys and girls a wholesome appreciation of the life history of peoples whom we consider to be in low stages of culture.

X. Art, Religion, Amusements, Education. If so desired, the immaterial culture of primitive folk may be presented under these headings.

Now that I have indicated in this very tentative way something of the content of the subject as it might be presented by the Second Method, I will call attention to its application to another portion of the school curriculum, namely, manual training. The basis for the presentation of manual training in most of our schools is the industrial one. For example, when clay is the medium for manual work, pupils are introduced to the methods of making pottery by hand and by machinery, to the processes of glazing and of firing; if possible, they are allowed to see an Indian woman making a jar by her primitive methods; they visit some potter using the wheel; they are taken to Trenton to see the most modern commercial process, and to Tiffany's to see the art product. When wood and iron are the media, there

opens up similarly the historical development based upon the crude uses amongst primitive folk. When pupils work in the textile industries, then the history of cotton, flax, silk, wool, fibers, etc., comes into prominence.

This phase of primitive history or industrial history, when presented as a unit in the eighth grade, or the first year of high school, in addition to the first-named purpose of laying the foundation for the structure of history proper, serves the additional function of unifying the different departments of industrial work—manual training, domestic science, domestic art, industrial art—by grounding them upon the same foundation,—the historic foundation.

Suggestions Regarding the Presentation of the Subject

In the absence of definite texts in primitive history, the work can easily and profitably be carried on by the laboratory method. It would be fruitless to attempt to give a bibliography for the whole history in this brief space, so I will illustrate with some of the material on hand for one chapter only, that on Travel and Transportation.

Original sources:

Spencer and Gillen, *Native Tribes of Central Australia.*
Roth, *Queensland Aborigines.*
Schmeltz, *Album of the Congo.*
Annales de Musée de Congo.
Stow, *Native Races of South Africa.*
Boas, *Central Eskimo;* report of the Bureau of Ethnology, vol. 6.
Eskimo of Baffin Land; report of Bureau of Ethnology, vol. 15.
Nelson, *Eskimo about Behring Strait;* report of Bureau of Ethnology, vol. 18.

Secondary material:

Mason, *Woman's Share in Primitive Culture.*
Travel and Transportation.
Origins of Invention.
Basketry; report of the National Museum for 1902.

Deniker, *Races of Man.*
Ratzel, *History of Mankind.*
Joly, *Man before Metals.*
Starr, *First Steps in Human Progress.*

Books of Travel, such as:
Nansen, *Across Greenland.*
Peary, *Arctic Journal.*
Barth, *Travels in Africa.*

Illustrative material:
Ethnological reports.
Mason's book on basketry.
Concrete objects and models in museums.

Secondary material and books of travel should constitute a classroom library for constant use by the pupils. The original sources, some or all of them, easily procured from any good library, should be kept in the custody of the teacher and referred to by specific pages for the definite facts desired.

In New York and other large cities the museums form a very valuable adjunct to all work in history, and especially in primitive history where so many contrivances for transportation and travel are illustrated by true ethnographic objects or by models. With the generous and tactful use of such illustrative material and with the beautiful illustrations which the Bureau of Ethnology and the National Museum furnish, there is no question but that primitive history can be kept thoroughly alive and closely tied up with the everyday life and the natural interests of every high school boy and girl.

REAL PROBLEMS IN GEOMETRY

By James F. Millis

Outline

I. Geometry as a science.
   1. How geometry got into the secondary schools as an abstract science.
   2. Reasons why so taught at present.
      a. Tradition.
      b. College entrance requirements.
      c. View of education as a discipline.
      d. Teachers not prepared to teach it otherwise.

II. Geometry as an instrument in living.
   1. View of education as for the present, as well as future.
   2. Implications for the teaching of geometry.
      a. Pupil, not the subject matter, should be made the center.
      b. Geometry should grow out of pupil's experience, and should be made an instrument in the process of living.
      c. Method: Begin with real situation in pupil's experience, developing system of organized knowledge. Build up geometry around real problems.
   3. Obstacles to teaching geometry in this way.
      a. Differences in needs and experiences of individuals make mass teaching difficult.
      b. Difficulty of creating a reconstructed environment in the school.
      c. Lack of available material, or of organization of pupils' experiences.
   4. If taught in this way, all the requirements of geometry will be met.

III. Expedient: Follow present plan of teaching, but use real problems freely in place of abstract exercises for drill.

IV. Applied problems.
   1. Kinds.
   2. Sources.
   3. Illustrative problems.

In a preceding paper it was briefly indicated that one of the ways by which the teaching of geometry could be improved, on the side of content, was by the use of genuine, practical problems, which have been given the name of *real problems*. It is proposed in this paper to go a little more deeply into the discussion.

Geometry is taught in secondary schools to-day as an abstract, deductive science. Let us note briefly how it came to be so.

The earliest traces of geometry that have been found are Egyptian. There is evidence to show that geometry originated with the Egyptians in a practical way. It was developed by them from a practical need, in their attempt at land surveying. In fact, the name *geometry* came from terms used by the Greeks, meaning the science of earth measurement. It was primarily and solely, with the Egyptians, a practical instrument growing out of the necessities of a concrete situation, and conceived only as a part of that situation. With the Egyptians geometry consisted only of a few empirical facts. These were not organized into a science. There were no proofs given for the rules. Some of their rules were false; such as that the area of an isosceles triangle equals half of the product of one side by the base.

The Greeks, who had commercial and other relations with the Egyptians, gathered up the Egyptian geometry and transplanted it to their own shores. Greek scholars and philosophers traveled and studied in Egypt.

The Greeks were of a speculative, philosophical mind, and they began to study geometry in their schools of philosophy. It was studied by the Pythagorean school, the Platonic school, and others. By the Greeks geometry was developed into a science. The subject was treated by many men. Euclid, about 300 B.C., collected all of the geometry known at his time into the *Elements*, arranged it as a deductive science, and gave the proofs of propositions. Since the time of Euclid, little has been added, in the way of content, to elementary plane geometry. The content of geometry adapted to the speculative minds of the Greek philosophers has been assumed to be adequate to meet the needs of modern American boys and girls.

When the works of the Greeks were transferred to the western world, several centuries later, geometry, as the Greeks had left it, was taken up by the western world. It was taught as a science in the early universities of the Middle Ages. The universities continued to teach it.

In time much that was formerly taught in the universities, and

in our country in the colleges, was handed down to the secondary schools. Dr. Broome's research on college entrance requirements in the United States shows how, by gradually raising college entrance requirements, geometry has been forced down into the secondary schools. This is how geometry as a science, with its old Greek content, has come to occupy its present place in the education of boys and girls.

I have already intimated some of the reasons why geometry is taught as an abstract, deductive science in secondary schools now. Its content is determined by tradition. The force of tradition will offer great resistance to a change. It is difficult to break from the old. Again, college entrance requirements will give us but little leeway. They require a knowledge of a certain number of theorems, whether they bear upon the practical life of the individual or not. They allow us no chance for experiment or change. The only way to meet them in our crowded course of study is to drive home so many dry facts of geometry in a given time. The one important thing is to master proofs of these abstract principles in a logical sequence.

The view of education in all of this is that education is a discipline, looking primarily to the future. Geometry as a science is taught in the hope that the discipline in thinking obtained may help the pupils in other fields of thought, and in the hope that at some time in the future the student may find a direct practical use for it. Some do. As all know, this view of education is now discredited. But the teaching of geometry is going on in much the same manner as of old. This view of education as a preparation for a possible future, which most teachers have consciously in mind, and the disciplinary idea in education are closely bound together.

I shall not go into that discussion further. We set the pupil, therefore, at the task of reasoning with abstract geometrical concepts, building up theorem upon theorem, without thought of his present needs and interests, in the hope that such a course of mental gymnastics will aid him in his work in the realm of thought, and in the hope that some day he may turn his knowledge so acquired to practical account. No doubt this work will

help him a little in his study in other fields, in so far as these have common elements, and he may enter a field of activity in adult life where he must make practical application of the technical facts of geometry. But a proper course in geometry that makes more use of the pupils' interests, the live material about him, and the principle of activity rather than passivity, will accomplish the same ends equally well—in fact, it is believed, far better.

There are, of course, other reasons why geometry is destined, at least for a time, to continue to be taught merely as an abstract science. One is that teachers are not prepared to teach it otherwise.

There is another view of education. It is that education is for the present as well as for the future; and it emphasizes the process of living in the present. It values the present fully as well as the future. It is conceivable that the life between the ages of ten and twenty-five is as important and worthy as the life between the ages of twenty-five and forty. From this point of view, the interests of youth are as valid as the demands of adult life. We would lay hold of the pupils' natural interests and experiences, and make them the means of education. This view makes the educative process the process of living. It does not undervalue a knowledge of mere facts as a means of future control and power in life, but it emphasizes the acquisition of those facts by an active process of real experiencing, living, doing, rather than by passive instruction.

This view of education has its implications for the teaching of geometry. It would make the pupil, not the subject matter, the center of the educative process. It would make geometry grow out of the pupils' experiences. It would reverse geometry as regards the content. Instead of the pupil learning the abstract truths of geometry from a book, with the hope of using them at some time in the future, it would develop the truths of geometry in connection with his actual experiences, and organize them into a logical system, making geometry an instrument in the process of living in the present. It will thus be all the more useful as an instrument in the future. On the side of content, then, we are to

get the material of geometry in a concrete form from actual life. So far as possible we are to rely upon the actual experiences of the individual pupil as concrete situations from which to start. These concrete situations furnish real problems in geometry. The whole subject of geometry is to be built up around these real problems. It does not mean that geometry is to remain a collection of empirical facts. These real problems taken from actual life are to be the starting point in the work; and the instinct of wanting to know the reasons of things and the tendency to generalize, inherent in the mind, will make it possible for the teacher to direct the student in the process of organizing his knowledge and building up a science of geometry beginning with his experiences. The whole process is natural and rational. But the position seems an extreme one to take. It is like making the sun the center of the planetary system, instead of the earth.

There are obstacles at present to teaching geometry in this way. In the first place, the great differences in the needs and experiences of individuals make such treatment difficult. No two individuals have exactly the same experiences. It is doubtful if a single individual pupil ever has enough experiences presenting real problems to make a sufficient foundation for the work. The number of problems in geometry, excluding purely mensurational problems, that the average person not engaged in a technical pursuit has to solve during a lifetime is probably small. And again, with the present scheme of completing the whole of the schooling of the individual in a few months, the opportunity for experiencing is very slight. However, the total experience of all individuals should contain concrete situations giving rise to an enormous number of real problems in geometry. A large class of these situations should appeal to all individuals, and hence a large number of real problems, though not met by each individual, should be of sufficient interest to the individual to warrant their use in building up the geometry.

To bring these situations into the school means to create a reconstructed natural environment for the pupil. If the concrete situations used are not the pupils' own situations, they must be reconstructed for them. This process is in itself difficult. And

yet a reconstructed environment is better than no environment at all,—the condition existing in the ordinary teaching of geometry.

A third obstacle to the practical work of putting the teaching of geometry upon this basis is the lack of sufficient available material at present; that is, the pupils' experiences have not been closely studied and the material for teaching organized and made available for teachers. The actual teacher himself has little opportunity to prepare the material. Observations of children and a study of their daily life will have to be made for concrete situations that may be laid hold of in the schoolroom. And persons conversant with the various vocations will have to gather from the different fields of labor those problems of geometry actually met that can be made of interest to the pupils in school.

However, it seems to me that if geometry can be taught in this way, if it can be made a means of actual living, and if it can be developed out of actual experiences, rather than learned from books as an abstract science with little or no immediate application, then it will meet all of the requirements made of it as now taught. It will furnish just as much mental discipline, just as good preparation for the adult life, if not better, and it will have the advantage of enriching the life of the school age and of furnishing it with a more powerful instrument for living. It will even cause more children to like mathematics.

In view of the fact that the material is not at hand for teaching geometry by building it up around problems taken from actual experience, we may try the following expedient. We may follow in the main the present plan of teaching the subject *as a science;* let the subject be begun with some situation presenting inductive and constructive work, the sequence revised, and certain changes in method made; but let us try to find some interesting applications of propositions as we go along. That is, instead of so many exercises of an abstract nature for drill, make a collection of genuine applied problems for drill, and use them. These applied problems, taken from actual life, may involve the same points in proof that the abstract exercises involve, but they have the additional advantage of being dressed in concrete form, and

having a human element in their content. They will add quite a little to the pupils' interest in the subject, and will give it a content that in itself is worth while.

These applied problems are of three kinds: mensurational; demonstrational, or those involving a geometrical proof; and constructional, or those requiring a geometrical construction. Mensurational problems in actual life are easy to find, yet no one has collected them. Demonstrational and constructive problems are not so easily collected.

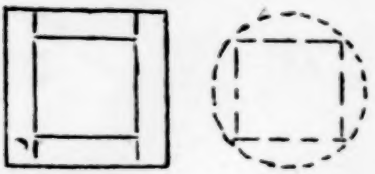
Aside from the actual activities of children, such as building tents, games, etc., there are other sources of applied problems. Some may be found in connection with the manual training shop-work in school. Some in the physical laboratory. Then there are many applied problems met in the different vocations that may be used; for example, in carpentry, navigation, bridge building, surveying, etc.

I have collected a few of such applied problems this year, and we are using them in the Horace Mann High School. Most of these involve a demonstration or a construction. I made no effort to collect mensurational problems, although a few are included in the list. I have not yet had an opportunity to try all of them with a class, so that I cannot say from experience which ones are good and which ones poor problems. But those that have been used have worked nicely.

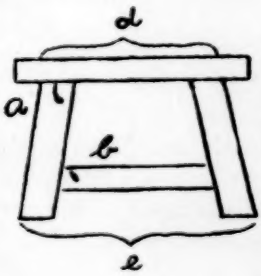
Field of Manual Training

1. In making a water-wheel we have a square block of wood which is to be made into the form of a regular octagon by cutting off the four corners. Show how this may be done.

2. In making an Indian club, pieces of holly are glued to the faces of a square piece of gum. This is then turned up in a

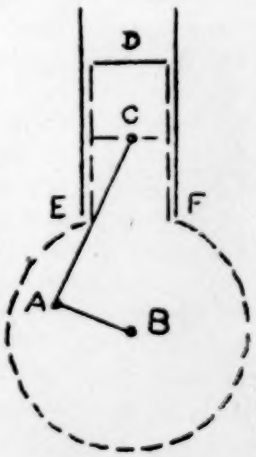


lathe, the holly producing oblong, oval light spots on the surface of the club. The thickness of the gum is 3 inches. In order to get a club in which these oval spots just touch at the point of greatest thickness of the club, how thick must the pieces of holly be taken?

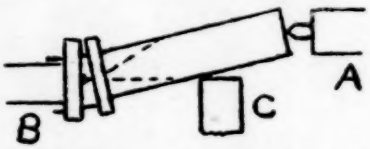


3. This is the cross-section of a foot-stool, in which the width of the top is to be 12 inches, d 8 in., e 12 in., and the lengths of the legs 8 in. In making the stool, angle a and angle b are first laid out on paper, and then a tri-square applied to them. Show how, from the required dimensions, to lay out these angles on paper.

4. In constructing a gas engine the piston D, which is in the form of an inverted cup, is 5 in. in inside diameter; the crank AB is 5 in. between the centers of the pivots, and the connecting rod AC is 17 in. between the centers of the pivots. How far from the mouth of the cup must the pin C be adjusted in order that the connecting rod may just clear the edge of the cup at E and F, the diameter of AC being 1 in.?



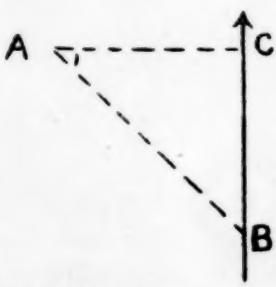
5. A cylindrical piece of brass, 8 in. long and 1 in. in diameter, is placed in a lathe, and a portion 3 in. long is cut down to a "taper," or conical form, ½ in. in diameter at one end and 1 in.



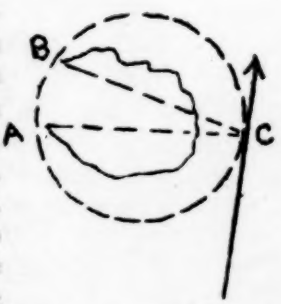
at the other. How much must the tail-stock *A* be set over out of line with the head-stock *B* in order that the edge of the knife *C* may cut the surface at the required slope?

6. A cylindrical piece of brass is to be put into a lathe. Show how to mark the centers of the ends, at which points it is to be supported.

Field of Navigation

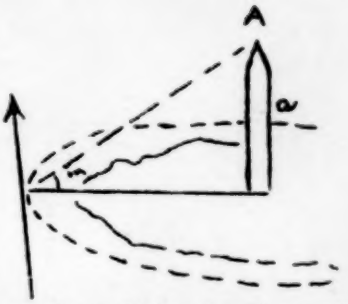


7. The distance *AC* at which a ship passes a lighthouse *A*, when moving in the direction *BC*, is obtained by observing the moment when the direction of the lighthouse makes an angle of 45 degrees with the course of the ship, and again when it makes an angle of 90 degrees, the distance the ship has gone between the two observations being noted. Show how to compute the distance at which the lighthouse is passed.



8. A ship is steered past a known region of danger as follows: A chart is made in which a circle is drawn through two points, *A* and *B*, which can be seen from the ship, and with sufficient radius that the circle incloses the danger region. The inscribed angle *ACB* is measured. Observations of *A* and *B* from the ship are made from time to time, and the course of the ship directed so that the angle between the directions from it to *A* and *B* never become greater than the angle *ACB*. Justify this method.

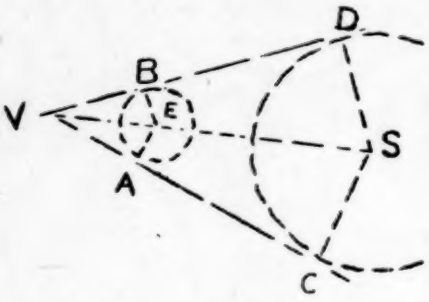
9. A ship is steered past a region of danger by observing the angle of elevation of a landmark A, in this region, as follows: The height a of A is known. A map is made by drawing a circle, with the foot of a as center, large enough to inclose the region of danger. Angle m is then computed from tables, and the course of the ship so directed that the observed angle of elevation of A never becomes greater than angle m. Justify this method.



10. The distance of an object at sea is estimated by making the following observations: With the left eye closed, point your finger, at arm's length, towards the object A; then, without moving the finger, close the right eye and look with the left one. The object will appear to have moved to B. The distance AB can be estimated by some means (in ship lengths, if the object is a ship of known length). The distance between the eyes of the average person is 3.1 in., and the distance to the end of the finger of the outstretched arm is 31 in. Show, then, how to estimate the distance to the object.

11. Why should a ship, in sailing between two ports of the same latitude in the northern hemisphere, in order to pursue the shortest course, veer to the north for the first half of its course, then back to the south?

Field of Astronomy



12. Since the earth is smaller than the sun, it casts a conical shadow in space (umbra), from within which one can see no portion of the sun's disk. If S is the center of the sun, E the center of the earth, and V the end or vertex of the shadow, prove that the length of the shadow, $VE = \frac{ES \times EB}{SD - EB}$.

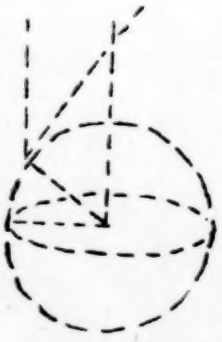
Approximately, $ES = 92{,}900{,}000$ miles, $SD = 433{,}000$ miles, and $EB = 4{,}000$ miles. Compute VE.

13. Three stakes are set in a canal two miles long, one at each end, and one in the middle, and all project the same distance above the water. By leveling, the middle stake is found 8 in. higher than the others. From these facts, find the diameter of the earth.

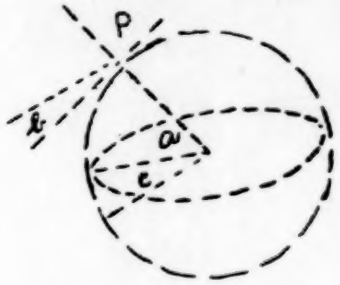
14. How much of the earth's surface is illuminated at once by the sun, barring refraction of light by the atmosphere? (See the dimensions in Ex. 12.)

15. Sailors find their latitude at sea by observing the altitude of the North Star. Prove that the latitude of the observer equals the altitude (angular distance above the horizon) of the North Star.

Note: Since the North Star may be considered as at an infinite distance, for practical purposes its direction from the observer is considered parallel to the axis of the earth.



16. The latitude of a place P on the earth's surface is obtained by observing the altitude of the sun (angular distance above the horizon) at noon. Prove that the latitude of P equals the differ-



ence between the zenith distance of the sun (90 degrees — altitude of sun) and the declination of the sun (angle it makes with the plane of the equator); i.e., $a = (90 - b) - c$.

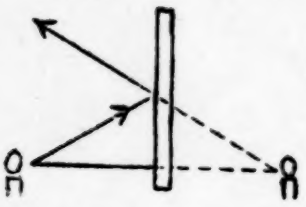
17. Prove that the portion of the earth's surface north of the parallel 30 degrees north is one quarter of the whole surface.

18. The stars appear to lie upon the surface of a sphere, called the *astronomical sphere,* with the earth at its center. Because of the daily rotation of the earth on its axis, all fixed stars, except the Pole Star, appear to move. Since the distance from any fixed

star to the Pole Star appears to be always the same, show that the apparent daily path of a fixed star is a circle.

Suggestion: If P is the position of the Pole Star, E of the earth, and S of any fixed star, ES and angle SEP are constant.

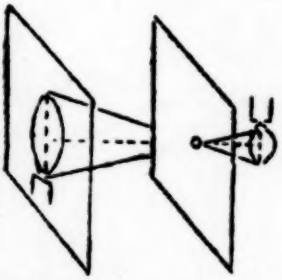
Field of Physics



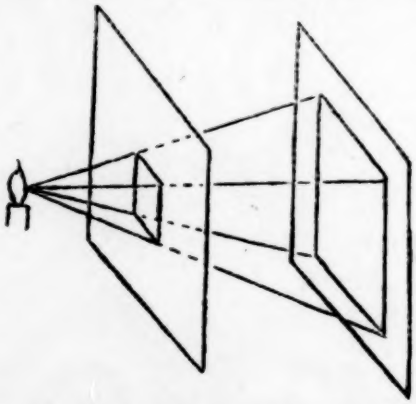
19. If an object is placed before a mirror, its image appears to be as far behind the mirror as the object is in front. Prove that this must always be so.

Note: When a ray of light strikes a reflecting surface, the striking ray and the reflected ray make equal angles with the plane of the surface.

20. The *camera obscura,* by admitting light through a small opening, throws images of external objects upon a white surface within a darkened chamber so that the outline may be traced. Show that the sizes of an object and of its image are proportioned to their distances from the opening.

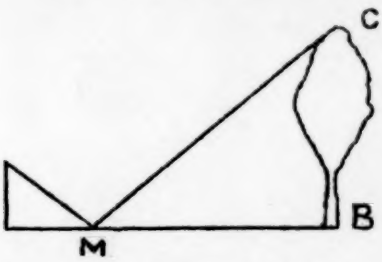


21. Show, by means of the accompanying diagram, that the intensity of the light falling upon a given area of surface varies



inversely as the square of the distance of the source of light from the surface.

22. A crude method of measuring the height of an object, in case more accurate instruments are not at hand, is by the use of a mirror. To find the height of an object BC, I place a mirror horizontally on the ground at M, and stand at a point at which

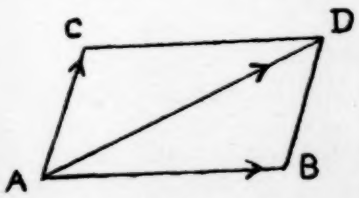


the image of the top of the object is visible in the mirror. Show how, by measuring certain distances, I can compute the height of the object.

Note: Light is reflected from the surface of a mirror at an angle equal to the angle at which it strikes it.

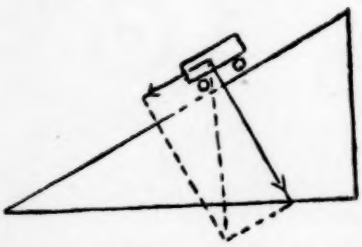
23. An easy way to find the volume of some irregular solids is to immerse them in water in a cylindrical vessel. Find the volume of a stone, if the diameter of the vessel is 14 in., and the difference between the water level before and after the stone is immersed is 12 in.

24. If two forces are exerted in different directions upon the same object at A, they have the same effect as a single force, called their *resultant*. If the directions and magnitudes of the two forces are represented by the lines AB and AC, the direction and magnitude of the resultant will be represented by the line AD, diagonal of the parallelogram having AB and AC as adjacent sides. Two forces, one of 100 lbs., the other of 200 lbs., are exerted upon a body at right angles. Representing 100 lbs. by a line 1 in. long, draw them to scale and compute the resultant. Check the result by use of the theorem of Pythagoras.



25. One of two forces exerted upon an object is 25 lbs., and their resultant is 60 lbs., acting at an angle of 30 degrees with the known force. By drawing to scale, construct the line which represents the other force, and by measuring its length with a ruler compute the force.

26. The resultant of two forces is 80 lbs. The two forces act, one at an angle of 90 degrees, and the other at an angle of 45 degrees with the resultant. By drawing to scale and measuring with a ruler, compute the magnitude of each of the forces.

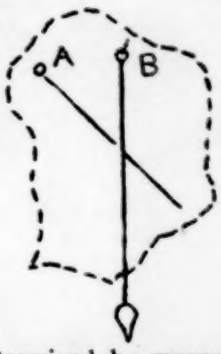


27. When a wagon stands upon an incline, its weight is resolved into two forces, one the pressure against the incline, the other tending to make it run down the incline. Show that the force along the incline is to the weight of the wagon as the height of the incline is to its length. If the incline makes 30 degrees with horizontal, with what force does a loaded wagon weighing three tons tend to run down the incline?

28. In railroad construction and mining the material is sometimes hauled in a tram pulled by a horse. If the pull of the tram in the direction of the track is, say, 200 lbs., and if the horse walks at the side of the track so that its pull is exerted at an angle of 25 degrees with the track, what pull must the horse exert?

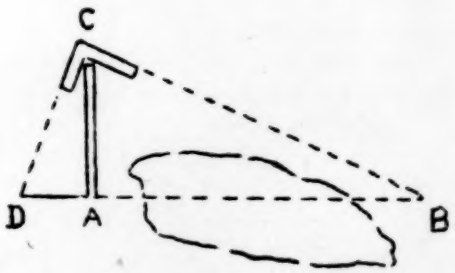
29. The center of mass of any flat triangular body of uniform composition is the intersection of the medians. Show how to locate the center of mass of a triangular board.

30. If any irregular flat body is supported on a pivot, it will revolve until the center of its mass falls vertically below the point of support. Show that by thus supporting it, first at a point A, then at a second point B, and using a plumb line to mark the vertical lines, the center of mass can be uniquely determined.



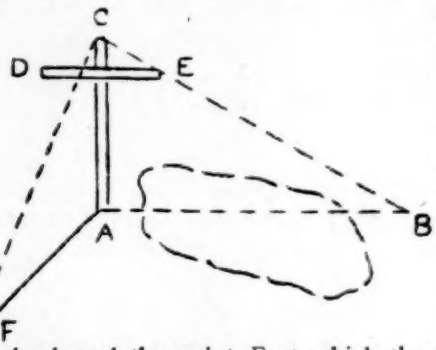
Field of Surveying

31. In the sixteenth century, the distance from A to the inaccessible point B was determined by means of an instrument called the "squadra." The "squadra," like a modern carpenter's square, consisted of two metallic arms at

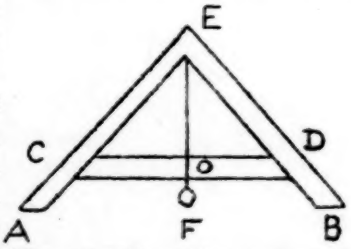


right angles to one another. To measure AB, the "squadra" was supported, as in the figure, on a vertical staff AC. One arm was pointed toward B, and the point D on the ground, at which the other arm pointed, was noted. By measuring AD and AC, show how AB may be computed.

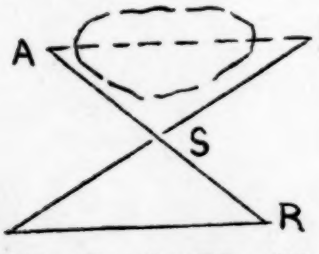
32. In the sixteenth century, the distance from A to the inaccessible point B was found by use of an instrument consisting of a vertical staff AC to which was attached a horizontal cross-bar DE that could be moved up and down on the staff. Sighting from C to B, DE was lowered or raised until C, E, and B were in a straight line. Then the whole instrument was revolved, and the point F at which the line of sight CF struck the ground again was marked, and FA measured. Show that $FA = AB$.



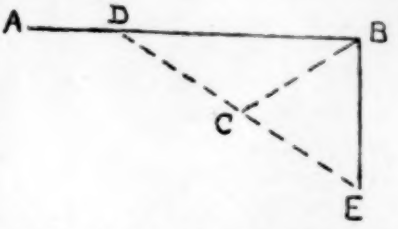
33. Before the spirit level was invented, an instrument for leveling consisted of three bars fastened together in the form of the letter A (AE, BE, CD). $AE = BE$, and $CF = DF$. A point O was marked on the tie CD, midway between C and D. A plumb line EF was attached at E. The instrument was held in an upright position, with the arms AE and BE resting upon the points to be leveled. Show that when the plumb line coincides with the point O, the points A and B are on a level.



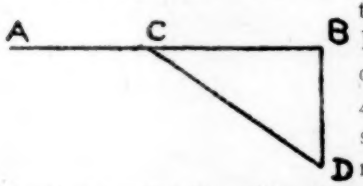
34. Justify the following method by which a surveyor measures the distance from A to the inaccessible point B. Locate a third point S from which the distances to A and B can be measured. Measure AS, and by sighting from A to S extend this line to R, so that $AS = SR$. Likewise, measure BS, and extend it to T so that $BS = ST$. Measure the distance BT. Then $AB = RT$.



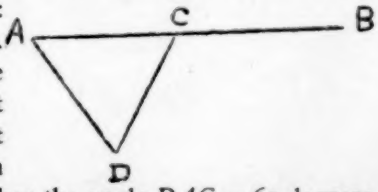
35. Justify the following method by which a surveyor may lay out a line perpendicular to AB at B. Select any convenient point C 50 ft. from B. With one end of the 50-ft. tape at C, swing the other end to D, in line with A and B, using a lining pole at D to aid in lining it from A, if necessary. With one end of the tape still at C, swing the other end to locate E in line with D and C. Then BE is the required perpendicular.



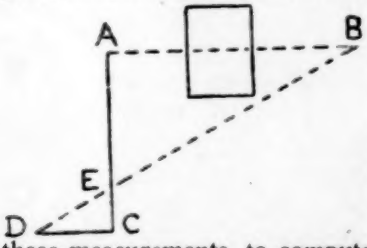
36. In marking off the foundation of a house it is necessary to construct a right angle at B, in the line of a wall AB. Prove that the following method is right: Measure off BC 25 ft. long. Hold one end of the tape at C, and the 40-ft. mark at B. Let a third person take the tape at the 25-ft. mark, and pull both parts taut, locating a point D. Then DBC is a right angle.



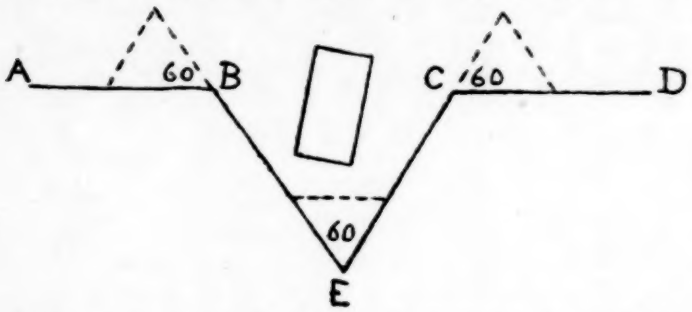
37. A surveyor often needs to lay off an angle of 60 degrees with a given line. If AB is the line, and A the point of it, show that he may do this as follows: Measure off AC 25 ft. long. With one end of the 50-ft. tape held at A and the other at C, let a third person take the tape at the 25-ft. mark, and stretch both parts taut, locating a point D. Then the angle $DAC = 60$ degrees.



38. To find the distance from A to an inaccessible point B in a field, measure off AC at right angles to AB, measure off DC at right angles to AC, and locate E in AC in line with D and B. Measure CE. Show how, from these measurements, to compute AB.

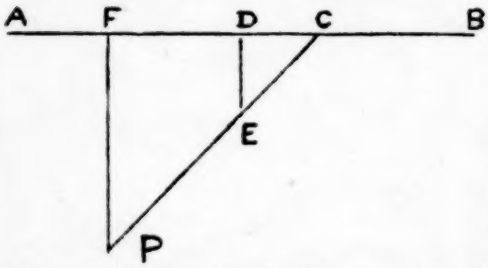


39. Justify the following method of surveying a line *AB* beyond an obstacle, such as a building: Measure off an angle of 60 degrees at *B*, and measure off *BE* sufficiently long to clear the

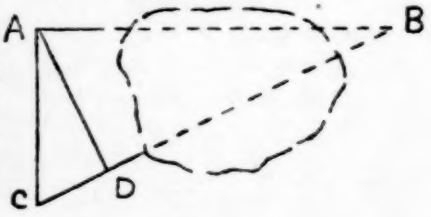


obstacle, as in the diagram. At *E* construct an angle of 60 degrees, and measure off $EC = BE$, as in the diagram. Then at *C*, measure off an angle of 60 degrees, and establish the line *CD*.

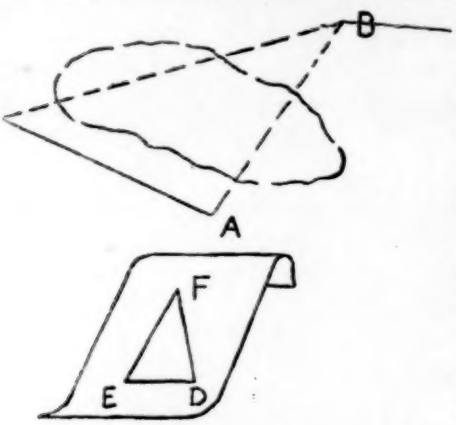
40. To lay out from a point *P* in a field a line at right angles to a distant line *AB*, such as the boundary line of a man's property. Measure off any distance *PC* to *AB*. Measure a convenient distance *CD* along *AB*. At *D* run a line *DE* at right angles to *AB*, until *E* falls in line with *P* and *C*. Measure *EC*. Compute the fourth proportional to *EC*, *DC*, and *PC*. Measure off *CF* on *AB* equal to this fourth proportional. Run the line from *P* to *F*. Prove *PF* is at right angles to *AB*.



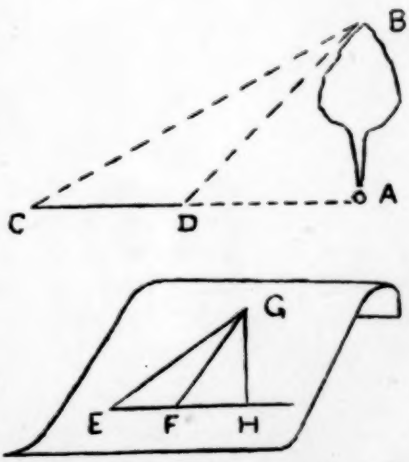
41. What method does the annexed figure suggest of computing the distance from *A* to the inaccessible point *B*, by measuring off distances in a field?



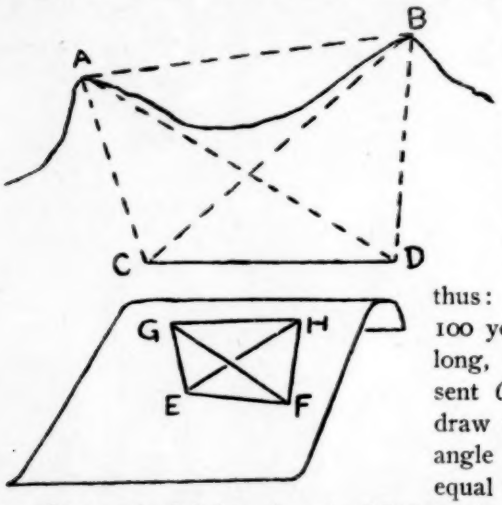
42. The distance from A to the inaccessible point B may be computed by drawing to scale. Measure off a convenient distance AC, and measure the angles BAC and ACB. Then draw a plan thus: Representing, say, 100 ft. by a line an inch long, draw ED to represent AC in the plan, and draw the angle FDE equal to the angle BAC, and the angle DEF equal to the angle ACB. Measure DF accurately with a ruler. Now show how to compute AB. If $AC = 500$ ft., the angle $BAC = 90$ degrees, and the angle $ACB = 60$ degrees, make the drawing, and compute AB.



43. To measure the height of an object AB by drawing to scale: Measure a distance CD towards A. Measure the angle ACB and angle ADB. Then draw a plan thus: Representing, say, 100 ft. by a line an inch long, draw EF to represent CD in the plan, and draw the angle HFG equal to the angle ADB, and the angle FEG equal to the angle ACB, and draw GH at right angles to EF prolonged. Measure GH. Now show how to compute AB. If $CD = 175$ ft., the angle $ADB = 45$ degrees, and angle $DCB = 30$ degrees, draw the plan, and compute AB.



44. To measure the distance between two inaccessible objects, *A* and *B*, such as mountain tops, by drawing to scale: Measure off a distance *CD*. Measure angle *ADC*, angle *BDC*, angle *DCB*, and angle *DCA*. Then draw a plan thus: Representing, say, 100 yds. by a line an inch long, draw *EF* to represent *CD* in the plan, and draw angle *HFE* equal to angle *BDC*, angle *GFE* equal to *ADC*, angle *FEG* equal to angle *DCA*, and angle *FEH* equal to angle *DCB*. Draw and measure *GH*. Now show how to compute *AB*. If *CD* = 500 yds., angle *BDC* = 90 degrees, angle *ADC* = 45 degrees, angle *DCB* = 60 degrees and angle *DCA* = 120 degrees, draw a plan, and compute *AB*.

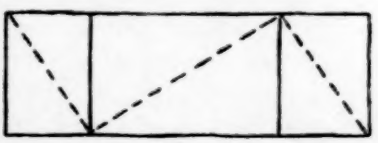


45. A baseball diamond is a square with 90 ft. to the side. The pitcher's box is in line with the home plate and second base, and 60 ft. from the home plate. Show how, with tape-line and stakes, to mark off the diamond on the ground, and to locate the pitcher's box.

46. A running track has two parallel sides and two semicircular ends, each a quarter of a mile long at the inner curb. Show how to go into a field and lay off such a track.

Field of Architecture, Bridge Building, and Roofing

47. An architect in designing a building with two wings connected by a link, makes the wings similar to the link and turned through 90 degrees, because such a building is most pleasing to the eye. Prove that in such a building design the concurrent diagonal lines are perpendicular.

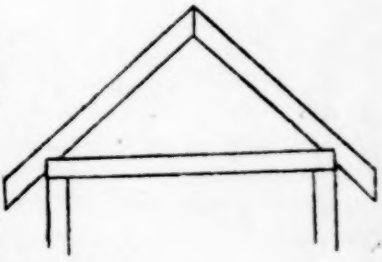


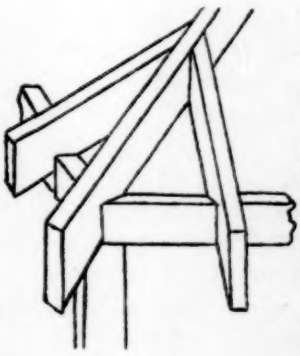
48. Experience has shown that a book, photograph, or other rectangular object is most pleasing to the eye when its length and width are obtained by the "Golden Section" of the half perimeter. Find, to the nearest integer, the width of such a book whose length is 8 inches.

49. In a bridge, a circular arch 18 ft. high is to span a stream 72 ft. wide. What is the radius of the circle at which the stones of this arch must be cut?

50. The cross-section of the train shed of a railway station is to have the form of a pointed arch, made of two circular arcs the centers of which are on the ground. The radius of each arc equals the width of the shed, 210 ft. How long must the supporting posts be made which are to reach from the ground to the dome of the roof?

51. A building is to be 30 ft. wide, and the roof is to have a rise of 2 ft. to 3 ft., measured horizontally. By drawing a plan to scale, construct the size of the angle at which the carpenters must cut the rafters. Also, allowing 18 in. for projection of the rafters at the eaves, compute the length of the rafters.

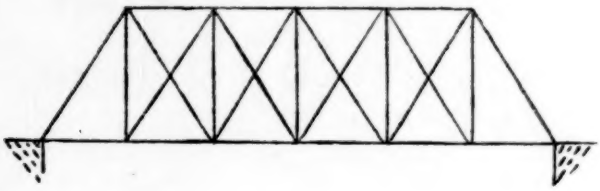




52. In a hip roof, the rise of each of the four faces of the roof is 2 ft. to 3 ft., measured horizontally. Short rafters are cut at an angle, and nailed to the four hips, or diagonal rafters, which extend from the corners of the building to the edge of the ridge-beam. Make the necessary computations, and, by drawing plans to scale, determine the angles at which the two adjacent faces of one of the short rafters must be cut.

Suggestion to the teacher: It would be well to have a model, cut from wood, showing how the rafter looks when cut.

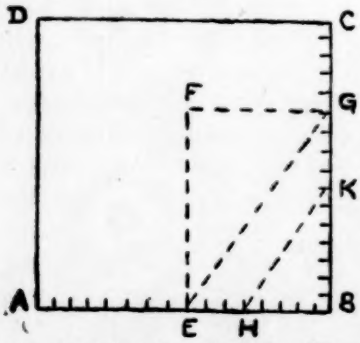
53. Show why a two-sided roof is braced so that it cannot collapse when one tie-beam connects each pair of rafters.



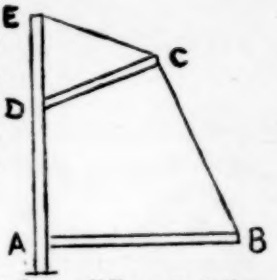
54. Why is a long span of a bridge, in which the truss is made with queen-posts and diagonal rods, as represented in the diagram above, sufficiently supported?

Unclassified Problems

55. How much belting does it require to make a belt to run over two pulleys, each 30 in. in diameter, the distance between their centers being 18 ft.?

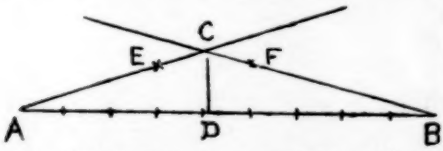


56. In an electrotype office in New York is a large board *ABCD*, ruled along the edges *AB* and *BC*. A man has a photograph from which he wants made a cut of a certain height, and wants to know at once the cost. The photograph is placed in the position *EBGF*. If the desired height is *BK*, a ruler is placed at *K*, parallel to *EG*, locating a point *H*. Show that from *HB* and *KB* the area of the cut is obtained, and hence its price.



57. In constructing a sail, the amount of surface of canvas *ABCD* is known, and the lengths of *AB*, *AD*, and *DC* are given. The angle *A* is a right angle. Show how to construct the angle between *DC* and *DA*.

58. Two trains on the same road start from different stations at the same time and travel towards each other, one at 30 mi. per hour, the other at 40 mi. per hour. The train dispatcher represents the distance between the stations by the line *AB*. He locates *E* 3 units to the right of *A* and 1 unit above *AB*, and *F* 4 units to the left of *B* and 1 unit above *AB*. He draws *AE* and *BF*, which meet at *C*, then draws *CD* at right angles to *AB*. Show that *AD* represents the distance of the meeting point from *A*, and hence determines at what siding one train must wait for the other to pass.

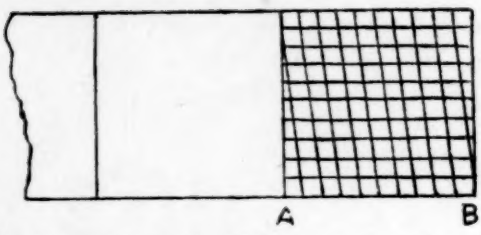


59. A belt runs over two pulleys, one of which is 4 ft. in diameter and driven by an engine at the rate of 100 revolutions a minute. What must be the diameter of the other pulley, if it is to turn a fan at the rate of 400 revolutions a minute?

60. In order to get a straight edge we fold a sheet of paper and crease it. Show that the crease must be a straight line.

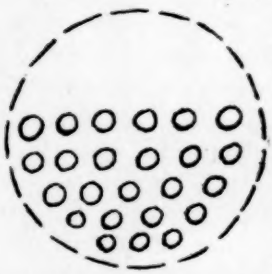
61. Why does a three-legged object, such as the tripod of a camera, always rest firmly on the floor? Why does a piece of furniture with four legs, such as a table or a chair, not always rest firmly on the floor?

62. Show that an object which appears of a certain height, when moved twice as far away, will appear to be comparatively of only one half the height.

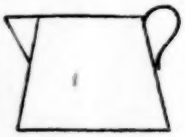


63. In the annexed figure of a "diagonal scale," which is used in measuring or laying off very short distances, *AB* is an inch. Show how, by means of this scale and a pair of compasses, to lay off 0.1 inch; 0.3 inch; 0.05 inch; 0.15 inch; 0.37 inch, etc.

64. In the construction of boilers, we wish to know the volume of the steam cavity above the pipes which convey the heat from the fire box through the water. In a boiler 4 ft. in diameter and 15 ft. long, the distance from the top row of pipes to the dome of the boiler is 18 inches. Compute the volume of steam cavity. Also, if there are 24 pipes, each 3 inches in outside diameter, compute the amount of the whole heating surface formed by these pipes.



65. A tinner wishes to make a coffee pot which shall be 8 in. deep, 4 in. in diameter at the top, and 6 in. in diameter at the bottom. Allowing a quarter of an inch for a seam, show how to cut the conical piece of tin from a sheet of it.



66. A gate post 5 ft. high casts a shadow 17 ft. long. How high is a house which, at the same time, casts a shadow 102 ft. long?

67. A baseball diamond is a square with 90 ft. to the side. Find the distance across from first base to third base.

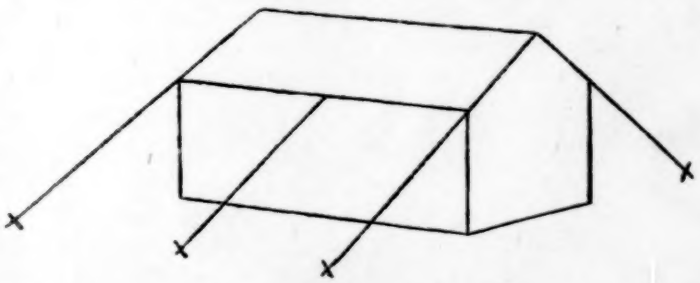
68. How, by means of a plumb line, can a mason determine whether or not a wall is truly vertical? Upon what proposition does this test depend?

69. In plastering a wall, how, by means of a straight board, can the plasterer tell when his surface is plane? What geometrical principle is here involved?

70. A running track having two parallel sides and two semicircular ends, each equal to one of the parallel sides, measures exactly a mile at the inner curb. Two athletes run, one at the inner curb, and the other 10 ft. from this curb. By how much is the second man handicapped?

71. The covering of a conical tent 14 ft. high, with the diameter of its base 12 ft., is to be made by sewing together eight equal pieces of canvas so that the seams all run down from the vertex. Compute the necessary dimensions, and show how to mark off and cut out each of these pieces from a piece of canvas.

72. In constructing a wall tent, with the height of the walls 4 ft., height to the ridgepole 6 ft., length of ridgepole 12 ft., and width of the tent 8 ft., what must be the dimensions of the

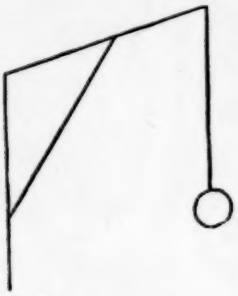


roof canvas, and what must be the lengths of the side guy-ropes? How much canvas will be required altogether, barring allowance for seams, etc.?

73. Through what angle must a 20-ft. rail of a railroad track be bent to fit a curve of a 400-ft. radius?

74. Pirates buried treasure 75 ft. from a certain tree, and 100 ft. from a straight path which passed the tree at a short distance. Show how to locate the treasure.

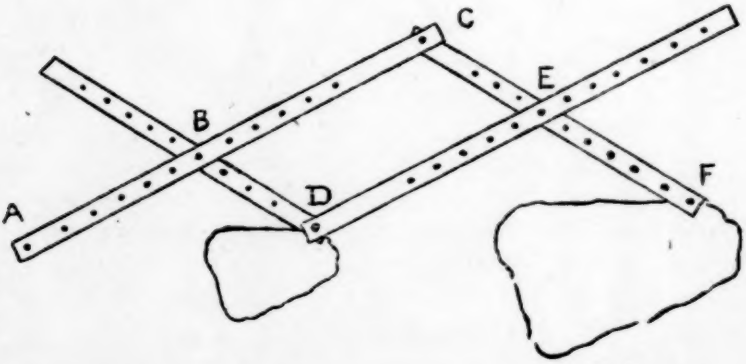
75. Why is a crane completely supported by a single diagonal brace?



76. In erecting to a vertical position the stud, or upright piece of timber at the corner, in the frame of a house, the carpenter places a carpenter's square in a vertical plane, with one arm of it first upon one and then upon the other of the two joists upon which the stud rests, and adjusts the stud until it touches the other arm of the square. What principle in geometry is he using?

77. Show that a square corner may be obtained by folding a piece of paper as follows: Fold the paper and crease it. Fold it again until the two portions of the crease coincide, and make a second crease. Then open out the paper. The creases form two perpendicular lines.

78. A pantograph is a machine for drawing a plane figure similar to a given plane figure, and is useful for enlarging and reducing maps and drawings. It consists of four bars, parallel in pairs and jointed at *B*, *C*, *D* and *E*. *A* turns upon a fixed pivot, and pencils are carried at *D* and *F*. *BD* and *DE* are so

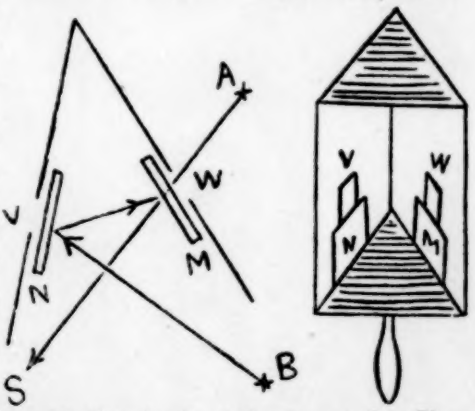


adjusted as to form a parallelogram *BCED*, and such that any required ratio $\frac{AB}{AC} = \frac{CE}{CF}$.

Show that (1) A, D and F are always in a straight line, and (2) the ratio $\frac{AD}{AF}$ remains constant and equal to the given ratio $\frac{AB}{AC}$, so that, if the pencil F traces a given figure, the pencil D will trace a similar figure, the ratio of similitude being the fixed ratio $\frac{AD}{AF}$.

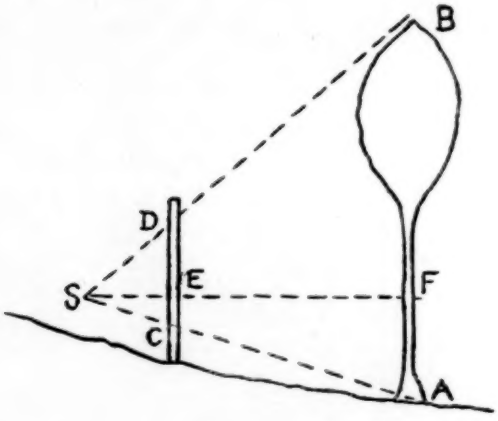
Suggestion: Prove triangle $ABD \sim$ triangle ACF.

79. In *forestry*, when it is necessary to lay off right angles, this is done by means of an instrument called a "right angle finder." It consists of a small metal box with a triangular bottom and with but two side walls. There are openings, or windows, W and V, in the side walls, and below these openings two vertical mirrors M and N are set at an angle of 45 degrees with each other. The observer at S looks directly into the box through the open side, and holds it so that an object A can be seen through the opening W. At the same time, the image of an object B is seen in the mirror M below W, in line with A. The principle is that B is just imaged in N, then this reflected to M, then back to the eye at S. Show that the directions to A and to B are at right angles.



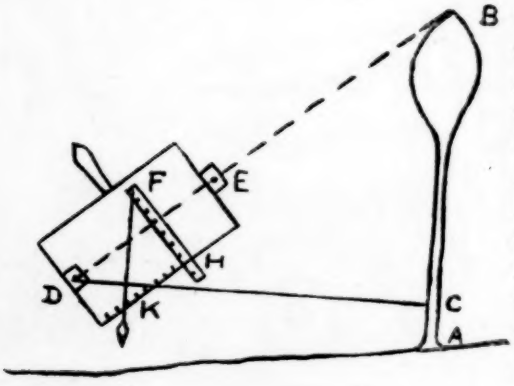
Note: Light is reflected from a surface at an angle equal to the angle at which it strikes it.

80. In forestry, when shadows cannot be used, the height *AB* of a tree is found as follows: A staff is held in an upright position *CD*. A man at *S* sights across the staff to the foot and



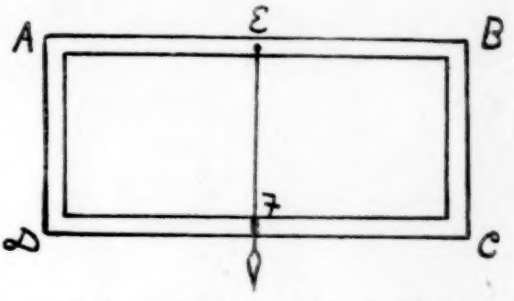
to the top of the tree. An assistant notes the points *C* and *D* when the line of vision crosses the staff, and measures *CD*. The distances *SE* and *SF* are measured. Show how *AB* may now be determined.

81. Faustman's "height measure" is an instrument used to get the height of trees in forestry. It consists of a rectangular frame with two sights, *D* and *E*, and a sliding rule *FH* which carries a plumb line *FK*. The edge of the frame *HK* and the rule *FH* are marked off to a scale. To find *BC*, the distance *DC* is measured, then the rule is adjusted so that the part *FH*



represents DC to some scale. The instrument is held so that D, E, and B are in a straight line, and the distance HK, which is determined by the plumb line, is noted. Show how BC may then be computed.

82. An instrument for leveling consists of a rectangular frame $ABCD$. E and F are the mid points of AB and DC, respectively. A plumb line is suspended from E. Show that when the plumb line coincides with the mark F, DC is on a level.



This instrument is shown in French books.

FIRST-YEAR HIGH-SCHOOL MATHEMATICS

Its Defects and Remedies

By Thirmuthis Brookman

Outline of Argument

I. Conditions of teaching.
The majority of students who enter high school, study one year of algebra, but never continue the subject.

II. Current criticisms.
Students are unable to use their knowledge of algebra in many of its elementary applications.

III. Scope of the first year's work in algebra.
The material contained in current texts emphasizes abstract rather than practical mathematics.

IV. Ideals underlying first-year algebra.
1. To train for practical work.
2. To give power to think with clearness, vigor, and effectiveness.

Are these ideals approximated:
1. In the choice of subject matter?
2. In the presentation of material?

V. Causes which have produced failure in teaching first-year algebra.
Power of tradition.
Remoteness of subject from practical checks.
Lack of preparation of teachers.
1. Source of supply defective.
2. Large cities do not always demand experience.
3. College entrance boards supposed to excuse teachers from improving present conditions.

VI. Suggested lines of improvement in teaching first-year mathematics.

High-school teachers must solve the problem by

1. Revising their code of ideals to be striven for.
2. Revising material taught and methods of teaching.
3. Demanding better preparation of teachers.
4. Closer coöperation with those in authority to secure constructive supervision.

NOTE.—By the phrase "practical problem" is meant the verbal statement of a problem expressing some quantitative relation based on everyday experience.

I. CONDITIONS OF TEACHING

Not the least important of the contradictions existing in our high schools is the subject of mathematics as taught in the first year. The usual curriculum is so arranged that the majority of high-school freshmen are required to study one year of algebra and are then given the privilege of electing or rejecting the subject in a second year. If a school requires two years of mathematics, the first year is usually devoted to algebra and the second to geometry. It follows, therefore, that every year a great number of boys and girls study one year of algebra, and never touch the subject again. This study is prescribed for those who must earn their living before the high-school course is completed, for those who graduate but never enter college, for those who enter college but study no mathematics, and for the incipient engineer. Some will continue the subject, but more will not. Since the first-year algebra may be imposed upon all students, good, bad or indifferent, the training and power derived therefrom should amply justify the compulsory nature of the subject.

An examination of the facts of the case reveals serious dissatisfaction with existing conditions and throws many grave doubts upon the wisdom of the selection of subject-matter, the presentation of material and the results obtained. In examining each of these topics, the discussion may be limited for the present to the case of those students who study no algebra beyond the first year. Later we will take account of those who prepare for college mathematics.

II. Current Criticisms upon High-School Algebra

The critics whose opinion may be considered of most value fall into two classes: those engaged in school work who have to build upon the results obtained by first-year students; and those who employ them in the practical world and expect of them knowledge of simple mathematical facts. The burden of the teacher is wearisome in its monotony. The instructor in chemistry finds that his pupils are unable to handle a simple proportion when expressed in the form of an equation: the reciprocal is a hidden mystery. The physics laboratory finds students unable to handle the practical problem and much restricted in their mastery of the symbolic equation. It has been said that the mathematics teacher is not expected to "teach physics." On the other hand, the physics teacher is not expected to teach mathematics. The instructor of college freshmen classes, composed of students who have studied usually three years of algebra and geometry, complains that they are able to manipulate symbols but are lacking in power to think abstractly.

From the world "beyond the pale" the criticism is fully as insistent, though less frequently heeded. An engineer of wide practical experience in hiring young men from the high schools of the United States and Canada during a number of years, finds them unable to work very simple practical problems with intelligence. "They are also lacking in mathematical common sense, and do not realize when they have obtained absurd results. They often offer the excuse that the subject had been studied two years previously." His judgment is confirmed by many other men in similar positions. They find either that the knowledge of algebra has slipped entirely away from the student, or that it remains a chaos of rules and processes which can be turned out to order, but over which the student himself has little control.

If the teacher in the school and the employer in business life find serious faults with the results obtained, the faith in the subject must be that of the high school principal or of the mathematics teacher; yet the high school principal will frequently

"parcel out" the subject of elementary algebra among various teachers equipped in other branches, and arouse no protest.

The teacher of first-year algebra, unless he prefers the subject because it is "easy to teach," often looks upon it as drudgery and takes the first opportunity to teach other classes in its place. It is difficult to find an instructor in mathematics who has thought out the problem of first-year algebra and knows why it is taught or why it should be taught to all students. He only knows that he is thankful that the subject does not fall to his lot.

III. Scope of the First Year's Work in Algebra

Since there are few advocates of first-year algebra *per se*, it becomes necessary to find its justification in the material taught. The amount of work covered in the first year is governed largely by the requirements for college entrance. If a school can cover the range of subjects known as "Algebra to Quadratics," it may obtain one entrance credit to college. Many schools, therefore, try to cover this ground within the year and divide the work approximately as follows:

General arithmetic and simple equations, 2 weeks.

Addition, subtraction, multiplication, division, 7 or 8 weeks.

Factoring, G. C. F. and L. C. M., 9 or 10 weeks.

Fractions, 6 or 8 weeks.

Linear equations, ratio and proportion, radicals, exponents during remainder of year.

The above shows that the practical problem receives scant attention until the latter part of the year, after algebraic habits have been formed. This lack of insistence upon the concrete application is emphasized by the college entrance examination in elementary algebra which often gives only one alternative practical problem in an entire set of questions. If the student is master therefore of the abstract problems he can frequently enter college. The elementary text-books certainly confirm this distribution of emphasis. What wonder that the science teacher and the business man, who look for power rather than percents, question what is accomplished in the first year's work!

"Algebra is intended to lay the foundation for practical work

in mathematics." How is this accomplished? *By postponing the practical problem until the latter part of the year,* slighting it if time is at a premium. By neglecting arithmetical values because arithmetic was mastered in the grades. By devoting nearly a quarter of the year to the study of types of factoring, *few of which ever occur in practical work.* By devoting a sixth of the year to mastering fractions, *many of whose forms are unique to the text-book in algebra.* By solving problems of a form which exists nowhere outside of the mathematics classroom. By studying theorems and subtle abstractions which play little part in the skill or accuracy required of the trained mechanic or the student in the laboratory.

Much may be gained by comparing the material presented in the current text-book with that included in the engineer's hand-book. The mechanic must have a few facts of algebra at his fingers' ends. These, together with the formulæ of his trade, are included in various engineers' reference books on which the following table may be based.

COMPARISON

between

Algebra as presented in current texts	and	*Algebra as presented in Surveyor's and Mechanic's Handbook*
1. Includes nearly all definitions necessary to logical development.		1. Includes only those definitions necessary to an accurate working knowledge.
2. Much labor spent in manipulating long and intricate expressions.		2. Expressions manipulated only in those forms used in practical problems.
3. Symbolic equations almost exclusively confined to use of letters a, b, c, x, y, z, and usually solved for one letter only.		3. Symbolic equations expressed in whatever symbols the formula demands and solved for any letter needed.
Types of factoring		
4. Grouped according to logical distinctions (rational integral algebraic factors over-emphasized so that student often thinks x^2-2 "cannot be factored").		4. Grouped according to the demand of the practical problems; x^2-1, x^2-3, x^2-4, equally emphasized, although the factors are not all rational and integral.

5. Combinations of fractions invented for the purpose of making use of forms of factoring previously studied.	5. Only such combinations of fractions introduced as occur in dealing with the ordinary quantitative relations of life.
Numerical quantities	
6. Usually avoided partly because they have been "taught in arithmetic" partly because they distract the mind from the mastery of abstract principles.	6. Introduced because they constantly occur in the usual formulæ.
Practical problems	
7. Inserted in chapters on the equation; often only practical in an artificial sense, and grouped to illustrate the principle previously considered.	7. Drawn from the needs of common life; grouped according to the working principle of enabling the student to use algebra in any of its simple applications.
Algebraic principles	
8. Grouped to develop logical order and give skill in mechanical manipulations.	8. Used only when they are more effective tools than arithmetical short cuts, logarithmic tables, the slide rule, common sense, etc.

We have compared the text-book of the student and the elementary mechanic, and find that the student attempts to master material never used by the mechanic, and fails to emphasize the few operations of which the mechanic must be a master.

The keynote to practical work is the equation. If first-year algebra is to give training for practical work, *the mastery of the equation should be the focus of each subject presented.* If each working principle, as developed, were immediately embodied in a series of equations, the solution of these would give the student a sense of power which is at present lacking. Many principles are not illustrated by concrete problems, because *no applications can be found which are sufficiently intricate to illustrate the principle involved!*

Surely good sense would show us how to lay a better foundation for practical work than we are at present doing in first-year algebra. Why could we not postpone until the second year,

work which gives little but logical power, and insert in its stead the practical applications which are constantly demanded in every-day life? By postponing theoretical work until the second year of algebra, we sift out those students who have but little ability or maturity for abstract work. We save the others from much confusion of mind and discouragement, but give them a mastery of the few tools which they are likely to need later. The class which continues the subject is composed only of those students who have some ability or interest in the work and who have gained from their first year's training a certain sense of power which comes from the ability to apply their knowledge of algebra to practical conditions. If the student is never likely to encounter practical problems requiring algebraic solution, the question may well be asked whether he should be expected to study as much algebra as is now the custom.

IV. Ideals Underlying the Teaching of First-Year Algebra

The claim is made that first-year algebra trains for practical work. We have seen that this claim does not usually hold. The second claim is hoary with antiquity; algebra gives power to think with clearness, vigor and effectiveness. In examining this claim we must consider the conditions prevailing in the average school. The strong teacher under favorable conditions can overcome many of the defects of the text; the teacher working under average conditions must, of necessity, rely largely upon the student's text-book. It is fair, therefore, to see whether the books train in clear, vigorous and effective thinking. If algebra gives power to think clearly, why are so many students hopelessly confused over their first year's work? Is it not because the teacher keeps in mind the logical sequence of the subject, rather than the stage of the child's development? Logic often finds the weakest places in the armor of the sophomore in college; surely the high-school freshman has little equipment therefor; yet the teacher's ideal must be maintained. What matter if the laws of pedagogy and psychology be contradicted at every turn?

The child of fourteen has little ability when it comes to grasping abstract principles. Nevertheless, the teacher must not waver from his ideal of perfect logical sequence. Again, the difficulty of grasping a new language, such as the symbolism of algebra, is very great. If the child is cut wholly adrift from his previous parts of speech, confusion is worse confounded. This difficulty the text-book naïvely meets, not by giving meaning to the symbolism employed, but by limiting symbols to a very few—almost to *a b c* and to *x y z*. Does this produce clearness in thinking or the reverse? The child who is learning a new language, unless he can keep its meaning clear, fails to relate it to any notions previously acquired. "From the known to the unknown," says pedagogy. "Emphasize the abstract," says the text-book. Is this our idea of *clear* thinking?

Its advocates claim that algebra trains in power to think with vigor. The athlete gains vigor by long continued training, by perfecting his own efforts, and not by watching a professional break a record. The child learns to think by doing his own thinking, not by absorbing the finished definition presented at the beginning of the subject; yet the book asks him to accept this kernel of crystallized information, to memorize it and to use it if he sees its meaning. Is such work vigorous thinking or an artificial process imposed by the will of others? If the student were led to develop the definition for himself by a series of skilful questions, gradually reaching the orthodox definition as the climax of his own development, would he not develop greater power in its mastery?

The switchboard mechanic is shown the keyboard and told how to make the connections. The text presents as practical a system of information when it introduces the student to the principles of algebra. Does such a process stimulate vigorous thinking or mechanical obedience? Why may it not lead the student to investigate and develop the principles of algebra for himself, by careful comparison and by analogy with arithmetic? By so doing, he would learn to work on his own initiative, learn to acquire definite concepts through his own efforts, and become a thinker of his own thoughts. The athlete trains for the contest

in order to make a definite goal; what goal is offered to the first-year student? Algebra text-books are written as a series of exercises. The purpose of their mastery or the relative importance of different subjects is rarely pointed out. Why may they not present the subject in its proper perspective, point out the goal toward which the student is striving, that he may feel a "compelling power from within" to gain a definite end? Let us take any of the current text-books in algebra and glance through their pages to see whether they make *us* think with vigor. On page after page we find principles expressed in a very few abstract symbols. When we have caught the method of presentation we find that the transformation of the symbols soon goes with a mechanical dexterity, and by and by the ability travels to the fingers. All we need to do is to watch the symmetry of the letters employed and the pencil writes the result; so it is with the student. He learns to establish an "eye and hand circuit" which hardly requires a conscious effort of the mind. One has but to note the difference between the student who *writes* such expressions as

$$(a+b)^2=a^2+2ab+b^2$$
$$(2a+3b^2)^2=4a^2+12ab^2+9b^4$$

and the student who *recites* the same with ***no visual image before him.*** Once his mechanism is perfected, does the average student accomplish any more vigorous thinking than the switchboard mechanic? A slight amount of common sense tells us that one cannot think unless he has something about which to think. Yet we carefully remove content from algebra by expressing it in a very few abstract symbols. Is this not a survival of the mere "forms of thought" whose spirit is dead?

Mathematicians claimed in former years that power to think algebraically gave power to think along other lines. Psychologists have shown that power to think algebraically gives very little power to think along other lines unless closely related to those used in algebra. Yet we have seen that algebra has almost no necessary content underlying its systems of symbols; it has therefore but little relation to other lines of thought; and

is therefore but little able to train in power to think except in terms of the algebraic symbols.

The practical judge of the student's attainment in first-year algebra is the teacher and not the theorist, and a summary of the judgments of many teachers has shown that the results obtained by the study are usually the following: First, for the student of an abstract turn of mind, a certain pleasure in obtaining the results of abstract problems; perseverance in obtaining a result by varying mechanical methods, by a discriminating use of algebraic symbols; a sense of the separation of algebra from the wealth of related subjects; lack of initiative in attacking practical problems. (Students who excel in abstract work are frequently below the average in dealing with concrete problems.) Second, for the students who see life concretely: patience and obedience in obeying rules imposed from on high; skill in imitation from working with symmetrical symbols. Bear in mind that we are claiming to produce vigorous thinking, that we are inflicting this subject annually upon over a hundred thousand children a year who will never touch the subject again. Do these results, the verdict rendered by many teachers, justify our claim that we are producing vigorous thinking?

The third and last claim made for algebra is that it produces effective thinking. Let any one who prides himself that this claim is verified visit the technical schools for trained mechanics. If a year's algebra has produced effective thinking, the very simplest elements of algebra, the mastery of the equation, the relation between the equation and the practical problem, should surely have given some power in handling the practical work required by the machinist, the structural ironworker, or the electrician. The trade schools for mechanics are attended by those who desire to perfect themselves in their chosen vocation, but who have not completed their high-school course. Yet the teachers in these schools are, as far as my experience goes, a unit in saying that the training given by first-year algebra has not accomplished the results which they had a right to expect; that the pupil is deficient in handling mathematical symbols unless expressed strictly "according to Hoyle"; and that he is almost

wholly lacking in power over those symbols in their concrete applications. The teacher is frequently an expert in algebra, but sees its defect and suggests its remedy. "The theoretical work in algebra meets no demand of the practical mechanic. He needs to become a master of the simple equation in its concrete forms." The engineer's hand-book confirms this statement. Of over a hundred formulæ, gathered at random from Kent's *Engineers' Hand-book,* few demand a more advanced knowledge of algebra than that required to solve the following equation dealing with the heating surface of a building:

$$N = \frac{36.04}{\frac{T_s - T_1}{T_0 - T_1}} - .369$$

yet here the student fails utterly. The equation contains decimals, from which he graduated in the grammar school; capitals which he never met in mathematics, and not a sign of the familiar *x, y* or *z*. A glance at the formulæ which are typical of the mechanic's work, shows but the faintest relation to the forms of equation found in our text-books. The laborious processes of long multiplicaton and division, of catchy factoring and complex fractions, which cover the paper, but reduce to zero in the last line, are wholly lacking. The simplification of practical formulæ requires the use of common sense rather than obedience. It requires sometimes the use of tables and short cuts of which the first-year student never dreams; it requires an accuracy which gives power rather than credits; it requires the student to think in terms of daily life rather than in terms of passing an examination. Let those who still linger under the delusion that first-year algebra trains in effective thinking visit the technical schools whose students have not run the gamut of high-school mathematics. Let them get the teacher's unguarded and unbiased opinion, based on the mathematical power which he finds present or absent among his pupils.

First-year algebra fails to lay the foundation for practical work. It fails to train in clear, vigorous and effective thinking. The orthodox may say that the proofs have been drawn wholly from a consideration of those students who never intend to con-

tinue their work in mathematics. If this be true, the proofs are drawn from the majority of cases. A hundred and sixty thousand students a year are required to study the algebra previously outlined, although they will never continue the subject. Either they have no mathematical ability, or their bent is literary or artistic, or home conditions are such that they cannot continue their education, yet they may be required to use what mathematical ability they have in practical vocations. The minority of students who study first-year algebra continue the subject through high school, and less than three per cent. of the first-year class continue the subject in college. If we give the rank and file a sense of power in their first year's work and give the commissioned officers a theory—which they and they alone are able to grasp—during their second year of algebra, are we not acting with far more common sense than at present? To-day the first-year student begins algebra in order to study advanced algebra, to fit himself as a teacher of mathematics, to teach elementary algebra! Or as Perry says: "10,000 students mentally destroyed for the sake of producing one man fit to be a mathematical master of a second-rate public school."

By giving the college student a sense of power in his first-year algebra, we certainly cannot do worse than at present and may do better during his second year's work. He is therefore not injured by the process which makes mathematics a powerful tool for the private in the ranks of the high-school student.

V. Causes which have Produced Failure in Teaching First-Year Algebra

It is not difficult to say why so much emphasis is placed upon systems of logic of recognized standing. Through many centuries, from the schools of Gamaliel and Duns Scotus to the schools of American mental gymnastics, they have been "taught according to the perfect manner of the law of the fathers." But why should this practice become universal? The students of Gamaliel and Duns Scotus and of the professors of logistic in the modern universities were selected for their peculiar gift and were rarely under eighteen years of age. The students of the

public schools are practically compelled to study the system of algebraic logic and are rarely over fifteen years of age. The yoke of our fathers was borne by a chosen few, why should it be borne to-day by the unwilling many? With the development of the modern science of algebra, with its exquisitely simple symbols from which content can be so readily removed, came its mighty power as the tool of the higher mathematician. Modern analysis became possible. Quaternions and systems of algebra, hitherto undreamed of, sprang into existence, until now, because a few mathematicians can reach the "roof of the world," we feel that all children should be turned adrift among the foot-hills.

A second cause for the lack of judgment and good sense shown in our present teaching of elementary algebra is its peculiarly protected nature. The general public, a conservative factor of no little importance in our school system, can judge for itself whether a student is becoming a master of French or arithmetic, of English or—to a certain extent—of history, but how many parents know when their children are becoming masters of algebra? The subject has slipped from them like their youth; they are wholly dependent upon the teacher's judgment. The child in many cases will never build upon his foundation of algebra, so that his weakness will not be detected. He can cover the page with symbols glibly enough written, so that his lack of thinking power is not realized. The banker or the tradesman who employs high-school students can estimate their arithmetical training in a week. Who but the teacher of industrial mathematics can estimate the training of a student in first-year algebra? The third and most potent cause of failure is deplorable, yet not hopeless, since it is capable of remedy; it is the low standard of many mathematics teachers.

Expert psychologists tell us that no period of development is of greater importance than that of the high-school freshman, yet who has applied the laws of pedagogy in presenting this subject which almost all freshmen are required to study? Modern psychology has done much to sift the wheat from the chaff in the teaching of arithmetic, yet who has applied the same criteria to the teaching of algebra? Mathematics teachers are drawn

from the colleges of the country. How many of these claim to give courses in the pedagogy of mathematics? How many of the professors of this subject are in direct and vital contact with the problems of the high school? Between the rich field of discovery in pedagogy and psychology and the training of the mathematics teacher exists a great gulf, which might be bridged by courses in practice teaching; yet from how many is practice teaching demanded as part of their preparation?

Were the standards of the teacher to be raised, large cities must inevitably abandon their present pernicious habit of employing high-school mathematics teachers who have had no experience. Where is there greater congestion than in the large city? Where can greater harm be accomplished by the poorly trained teacher?

In the eastern sections of the country, mathematics teachers fall into another peculiar temptation. They may use the college entrance examination board as an excuse to avoid giving time and attention to the advancement of the standards of elementary mathematics. Is there any body of men who carry a greater burden of criticism, yet who have accomplished as much for the colleges of the country? This board was formed for the purpose of unifying the requirements of students who enter college. It must therefore base its standards upon practicable conditions and demands of those entering college. Why should it be used as an excuse for not raising the standard of teaching high-school freshmen? The college entrance board is a conservative force, yet it is not opposed to change. Between the years 1899 and 1903, this very body of men changed their mathematics requirements in response to the demands which had grown up in the high schools. When any demand is sufficiently worthy and practicable, we can count upon their coöperation for progress in education. The work of the college examination board fills a distinct want in secondary mathematics. The chief evil which has developed with the growth of the present system is not irremediable. It is the judgment of many teachers that it is possible to develop power to pass college entrance examinations without developing a corresponding degree of power in mathematics. Each entrance

examination has its characteristic peculiarities. For example, the tutor training candidates to pass an examination given by the college entrance board, does not expect his student to pass a West Point examination without two or three weeks additional training to meet the special demands of the West Point board of examiners. The tutor for West Point finds the same difficulty in preparing his students to meet the demands of other boards. A football coach studies the tricks of each opposing team, and if he does not coach from the sidelines, equips his nine with offensive and defensive plays, to secure victory during the second half. A similar situation prevails among mathematics coaches. They inquire which examination their candidate is to face, study its peculiar tricks, obtained from examination questions of previous years, and arm their students accordingly.

Wherein lies the difficulty?

The questions seem aimed to discover *technical skill in handling a few points* rather than to reveal the *mathematical power* of the student.

Wherein lies the remedy?

Introduce questions whose answers will reveal the student's mastery of the subject as a tool, and his ability to make it count in the conduct of life.

With whom lies the remedy?

With the high-school teacher of mathematics. The college entrance board of examiners is coöperating more fully each year with the secondary school to make its work effective.

VI. Suggested Lines of Improvement in Teaching First-Year Mathematics

The algebra which we teach the first-year student does not satisfy the reasonable demand of the practical man. Our methods of teaching are not in accordance with the most fundamental laws of pedagogy and psychology, and we must not use the examination board as an excuse for poor teaching. We are requiring but little practical training of the mathematics teachers of the future. The college professor is more keenly interested in the college candidate than in the high-school freshman. Where,

then, does the remedy lie? How can we reach the root of the difficulty? We must appeal to the expert, not to the theorist or to the school officials, but to those who should and do know more of the subject than any one else—to the teachers of high-school mathematics and especially of algebra.

The working out of practical improvements must of necessity take place in the classroom. The inspiration to perform these experiments can frequently be furnished in far larger quantities than at present by the head of the department. To make this possible it is necessary that superintendents and principals so encourage the heads of departments that they may be free to help their assistants instead of spending their best strength in making technical reports.

We have drifted naturally into the habit of teaching algebra because "it always has been taught"—we have taught it in the stereotyped fashion because we have been more interested in the logic of the algebraic system than in the development of the adolescent mind—we have shifted responsibility to the shoulders of the examination boards because we have been following the line of least resistance. We have failed to realize that the time when all students studied Greek, Latin and mathematics has passed away. Our schools are filled with boys and girls who will never see the inside of a college, but we have failed to adjust our teaching to their necessities. Our children look up but are not fed. It has been so much easier to avoid the drudgery of first-year algebra by pursuing a rich outside life, or by teaching higher classes, that our heart is not in the work.

I have stated the problem. Can we not bring to it the richness of our experience, illuminate it with the radiance of modern pedagogy and applied psychology, use the machinery already to hand in the mathematical societies springing up throughout the country to find a solution of the problem of concrete and abstract algebra, which shall give to our boys and girls a more reasonable, perfect and fitting education than the present?

To make the work of reconstruction practical, I suggest the following definite lines of inquiry:

1. What are the ideals sought in teaching a single year of

algebra? Are these ideals of such value as to justify the present practice of requiring a single year of algebra from 160,000 students who do not continue the subject?

2. If the material included in the first year's work is poorly selected, what changes should be made?

3. If the method of presenting material does not accord with the fundamental principles of psychology and pedagogy, what changes should be made?

4. If the training of teachers of first-year algebra is insufficient to equip them to progress in the solution of the problem outlined in this paper, how may this defect be remedied?

5. What steps may be taken to arouse an interest in the solution of this problem among teachers of mathematics themselves: this interest to tend toward such solution of the problem as shall later arouse the coöperation of principals, superintendents and college entrance boards?

6. What mode of examination would reveal the student's insight into mathematics, rather than his power to juggle with mechanical symbols?

CO-OPERATION AND CORRELATION IN LANGUAGE TEACHING IN THE HIGH SCHOOL

By Alexander J. Inglis

In view of the ever-increasing demands which are being made on the time and energy of the pupils of our high schools, it is fast becoming an imperative necessity that some effort be made to meet the difficulty of a crowded curriculum. How can it be done? How can we meet this increased demand and at the same time maintain a proper standard in the quality of our high-school work? The enlarged curriculum has been in great degree due to the increased demands of society, and the tendency seems to be toward a more extensive curriculum rather than toward a less extensive one. It is therefore improbable that the issue can be met in any great degree by decreasing the number of subjects taught or by lessening the amount taught in any subject. The situation is further complicated by the present system of college requirements, and, at least for those students who expect to enter college, little relief can be expected in the way of a shortened or less extensive course. It would seem that the one solution of the difficulty is to be found in a closer integration, a closer correlation of the subjects of the curriculum. This remedy has proved efficacious before this, and it is the purpose of this paper to show that its possibilities have not been entirely exhausted, at least along some lines. Some attempts in this direction have already been made in the various schemes for the correlation of the various mathematical subjects, such as the "spiral method," and in the attempts to correlate the mathematical subjects with chemistry and physics.

In this paper an attempt will be made to show that we have not as yet taken advantage of the possibilities of correlation and coöperation in the teaching of the languages. The particular phases of the question which are treated, and an indication of the

content of this paper may be found in the following propositions and recommendations with which this paper is concerned:

1. That, in the arrangement of language classes, wherever possible, a distinction be made on the basis of the previous study or knowledge of another language.

2. That students should not be permitted to begin two foreign languages at the same time.

3. That a uniform and consistent terminology be adopted by all teachers and in all classes of a particular language in a given school.

4. That, wherever it is possible, a uniform and consistent terminology be adopted by all teachers and in all classes of language study in a given school.

5. That every teacher of a foreign language should, so far as is possible, familiarize himself or herself with those elements of the other languages taught that will be of assistance in correlating the different languages of the school curriculum.

It will be noted that no one of these recommendations is particularly radical in its aim or at all new in its conception. Yet in practice each one of them is constantly violated even in our best schools, a state of affairs which is due not so much to an opposition in theory as it is to carelessness in practice and to a failure to develop a working system. The object of this paper then is not merely to argue for the acceptance of these propositions, but rather to indicate the manner in which they can be carried out, and the possibilities which they contain for improvement in our teaching.

Practically all of the above propositions are at the basis of the so-called "Frankfurter Lehrplan," where an attempt is made, and seems to meet with a considerable amount of success, to pave the way for the study of Latin by teaching French first and reducing the amount of time spent on Latin from nine to six years. The success of this scheme is an indication of the possibility of correlation of Latin and French, and the supporters of the plan in Germany have gone so far as to prepare a series of books with the particular aim in view of correlating language study in Latin, Greek, French, and German. The plan and its

possibilities are set forth in several of the German educational periodicals of the last ten years and in a pamphlet, "Der Lateinische Anfangs-Unterricht im Frankfurter Lehrplan," by Dr. Wulff of the Goethe Gymnasium. In practice the theory is exemplified in Reinhardt's "Lateinische Satzlehre" and Banner's "Französische Satzlehre." In Reinhardt's "Lateinische Satzlehre," for instance, each section explaining a Latin construction contains a cross reference to the parallel grammars of the series in French and German, and throughout the book there is constant comparison between the Latin construction and the corresponding French and German. The reasons for this are set forth in the preface of Reinhardt's book: "Den Schulen, in denen der Beginn des lateinischen Unterrichts dem des französischen folgt, ist die Aufgabe gestellt, einen möglichst engen Zusammenhang in der grammatischen Belehrung der verschiedenen Sprachen herzustellen. Also musste eine gemeinsame Grundlage für die Einteilung und Gliederung der Syntax gefunden werden."

Reference to the Frankfurter Lehrplan is made here to indicate the importance which has been attached to the problem of correlation of language study in Germany and to the manner in which the problem has been attacked there. There will also be occasion in the latter portion of this paper to refer to some features of the plan.

All of the languages which are now taught in our schools have many elements in common, and in the teaching of them we have many common problems. In many respects likewise the aims and methods of teaching the languages are much the same. It would seem a fairly tenable theory, therefore, that in teaching any foreign language, advantage should be taken of the sum total of a student's knowledge with particular reference to any other language which the student may have studied. For instance, from a student of Latin who has more or less knowledge of German or French, much more may be expected and demanded than from a student who enters upon the study of Latin without any knowledge of or training in any language other than English. So also of a student of French or German who has already studied Latin. If this theory is correct, it would seem evi-

dent that in the arrangement of courses of study and in the make-up of classes considerable attention should be given to the previous training of the members of the class in language study. This principle is recognized in many college courses, where for instance a certain amount of French or Latin is a prerequisite for a student taking up the study of Italian or Spanish. Again, the whole course of school Greek assumes a previous study of Latin.

Where conditions permit, therefore, it would seem justifiable to group the classes of Latin or French or German on the basis of previous training in another language. I say "where conditions permit," for in small schools the small number of teachers and classes, and in large schools the complications of school machinery and of schedule-making offer great obstacles.

The problem of the precedence of Latin or German or French in point of time would properly enter into the discussion at this point, but as that question has been thoroughly debated in its various forms on several occasions, no attempt will be made to take it up here. The question has been mooted many times in this country, and was brought up again by Dr. Collar in a paper read before the School Teachers' Association of New England in 1906, when he advocated the prior study of French as a preparation for the study of Latin. In Germany the question has been threshed out thoroughly by the advocates and opponents of the Frankfurter Lehrplan. It is sufficient for our purpose to note here that whichever of the languages be taken up first, that language may be used as a basis for teaching the others. If French be taken up before Latin, a less abrupt transition of language is offered to the pupil. If Latin be taken up first, the student will get a good foundation for the study of French.

The question, however, with which this paper is chiefly concerned is not so much the question of a change of courses, nor the relative value of the languages, nor yet their relative position in the school curriculum. We are to consider the question of the languages under the existing conditions, and, if possible, discover how and to what degree it may be possible to take advantage of a student's knowledge of one foreign language in

teaching him another, to point out some of the elements which the languages have in common, and to find some means of correlating those common elements. If this can be accomplished there will result: (1) an economy of time; (2) an economy in labor; (3) a gain in the understanding of the correlated languages.

Let us examine the present conditions, first as regards terminology and classification. There is at present a great confusion in terminology and classification not only in the teaching of different languages but also within the limits of any given language. Nowhere, perhaps, is this more evident than in the teaching of English. What one teacher calls the nominative case, another calls the subjective; what one grammar lists as an accusative case is called objective in another. In such a sentence as *John is a blacksmith,* "blacksmith" is variously denominated as "predicate appositive," "predicate noun," "predicate complement," "predicate nominative," and so on through all the names which the various grammarians can devise to burden the mind of the student and provoke the wrath of the teacher.

The purist familiar with historical grammar may insist on emphasizing the term "dative absolute" while "nominative absolute" satisfies another. The teacher of English may insist on the "infinitive in -ing" to the everlasting confusion of the Latin "gerund grinder."

The student of Latin learns in his first year perhaps to distinguish conditions as Simple, More or Less Vivid, and Contrary-to-fact (Allen & Greenough, Collar & Daniell). In his second year his technical vocabulary may be enriched by a second set of terms; Logical, Ideal, and Unreal (Gildersleeve and Lodge). In the third year the teacher may despise pedantry and label the same constructions: First Type, Second Type, and Third Type (Bennett). In the fourth year the student may combine his preceding knowledge of the constructions by designating the conditions as Class I or Real, Class II or Possible, Class III or Contrary-to-Fact (Harkness); and when he takes his college examinations the chances are that all he knows about conditions is a mass of confused and confusing terms. In the expression

Mihi usui est, it is useful to me, the construction of ***usui*** affords the complete Latinist at least five terms: "Object for Which" (Gildersleeve), "Purpose" (Allen & Greenough, Bennett), "End" (Allen & Greenough), "Service" (Collar & Daniell), or, if the teacher be a German, "Dative of the Thing."

German and French, being as yet somewhat young with us, have not acquired the rich confusion of terminology of which the Latin may boast and are somewhat freer from the confusion of terms, but the tendency exists, and we can find such illuminating terminology as "Genitive of the Secondary Object" (Thomas) and "Genitive of the Remoter Object" (Van der Smissen & Frazer) for the genitive in such expressions as ***Ich beschuldige ihn des Diebstahls.*** And judging from the varying terminology which can be heard in various classrooms these instances could be multiplied indefinitely.

In French likewise the terminology varies decidedly in the various grammars and even more in the usage of teachers. For instance, a few years ago in one of the examinations for entrance to Columbia a question called for information as to the position of the "relative pronouns." Plainly a very simple question, but unfortunately by the term "relative pronouns" the examiner meant what are commonly called "conjunctive pronouns" though purposely using the term "relative pronouns."

The obvious objection may be made to the pertinence of the preceding statements that a varying terminology of grammars does not necessarily mean a varying terminology for the student, since probably but one grammar will be employed in a given school. But it is the terminology of the teacher which the pupil must perforce follow and as he passes from one teacher to another in successive years complications may and commonly do result. These complications could very easily be obviated if all the teachers of a given language would agree on a general plan of terminology to be followed uniformly and consistently throughout the department.

The varying terminology which exists within the limits of a single subject is to be found probably in greater degree when we consider the entire field of the languages taught in our

schools. Practically all of the evils found in the members of the family of languages are to be found also in the entire group, and added to this is the fact that a term which may be consistently used in one language may be inconsistent with and vary from the terminology of another language. For instance the term "Ethical Dative," which is of very restricted connotation in Latin and forms but a small part of the "Dative of Interest," is made to include the "Dative of Interest" at least in one English grammar. Thus in the sentence, somewhat inelegant but pertinent,

I'll break his leg *for him.*
Ich breche *ihm* das Bein.
Frangam *ei* crus.
Je *lui* casserai la jambe,

we get a "Dative of Reference" in Latin, German, and French, and ordinarily in English; but, in the grammar referred to, this unethical action would give us an "Ethical Dative," or, what would be more appropriate to this particular sentence, a "Dative of Feeling."

If this varying terminology between the departments of language is admitted, then we are justified in this recommendation: That, in a given school, wherever possible, a uniform and consistent terminology be adopted by all teachers and classes in all language study: and that wherever this is impossible the teachers at least familiarize themselves with the terminology of the other languages.

The following incident will illustrate the scope and meaning of this recommendation. It was noticed in a certain class that such a dative as is found in the Latin *Sese Caesari ad pedes proiecerunt, they cast themselves at Caesar's feet,* was constantly referred to by the students as a "Dative of Possession." Inasmuch as the "Dative of Possession" in Latin is very clearly limited to a different sort of construction, this mistake resulted in considerable confusion. Upon inquiry it was found that one of the German teachers was employing the term for this construction in such sentences as *Ich wasche mir die Hände,* and a change of terminology was brought about with considerable gain.

While the insistence on a terminology and classification which

is, so far as is possible, uniform for all departments of language in a school is important, this is but a necessary antecedent condition to what may be considered of perhaps greater importance, a closer coöperation between the teachers of the various languages. To carry out this coöperation there is necessary on the part of each language teacher, not only some knowledge of the other languages taught but also some knowledge of the manner in which the other languages are taught. This is the principle which lies at the basis of such provisions as we find in some cases today. For instance, it is a fixed policy in some of our schools for a teacher to teach two or more languages, and in some cases a teacher of the classics is required to teach at least one class in English. In the German schools no teacher is licensed to teach unless he has at least two languages at his command. Whether this theory can be justified or not, whether or not we hold in theory what we carry out in practice, that the specialist in one language can accomplish more than a specialist in more than one language, it certainly is possible for our teachers to know enough of the rudiments of the languages taught in our schools and the methods of teaching them to avail themselves of this knowledge in teaching.

We all know the value of illustrating a word usage or construction in one language by a parallel instance from another, and we all make more or less use of that principle. But this knowledge we avail ourselves of for the most part in a haphazard manner when a particularly noticeable passage may call to our minds the remnant of some long slumbering knowledge of the other language, and sometimes we even make mistakes in trying to illustrate the point. There are but few teachers of language who have not had more or less training in at least one other language than English and the language which they teach. A careful examination of the possibilities of correlation between the languages, in some cases perhaps accompanied by a slight brushing up in the languages to be correlated, would add materially to the teaching power of the instructor.

In the remaining portion of this paper an attempt will be made to suggest some general lines which may be followed in securing

some measure of coöperation and correlation between the various foreign languages commonly taught in our schools. It is needless to say that these are merely suggestions and that the scope of this paper precludes the possibility of a complete treatment of the subject.

Latin and German

Reference has already been made to the grammars of Reinhardt and of Banner wherein parallel constructions in Latin, German and French are very carefully worked out, and an examination of these books will show the extent to which the correlation between those languages is possible. For instance, throughout the books we find such statements as:

"In lebhafter Erzählung wird das Präsens häufig statt des historischen Perfekts verwandt, *ähnlich wie im Deutschen statt des Präteritums, im Französischen statt des Passé Défini.*"

Probably the greatest aid which a knowledge of German gives to a pupil studying Latin, or a knowledge of Latin gives to a pupil studying German is in the conception of the meaning of inflectional forms and in an understanding of the more elaborate syntax. This, however, is a matter which will naturally force itself on the student's attention and is not a matter so much for the direction of the teacher as it is of the student's subjective development. The points of contact between Latin and German which are to be emphasized here are the various syntactical and other usages which those languages have in common and wherein there lies opportunity for the teacher of the one language to explain or illustrate a point in that language by reference to a parallel or variant construction or idiom in the other. Thus if the student of Latin who possesses some knowledge of German has difficulty in understanding that the three forms of the English present, *I praise, I am praising, I do praise,* are all translated by the one form *laudo* in Latin, a reference to the German *Ich lobe* may make the matter clear to him. If the student insists on translating the sentence *I have been two months in Italy* (implying continuance) by the perfect tense in Latin, a reference to almost any one of the modern languages which he may know may set him straight:

Ich *bin* schon zwei Monate in Italien.
Je *suis* en Italie depuis deux mois.
Iam duos mensis *sum* in Italia.
Io *sono* da due mesi in Italia.

If the pupil writes *Tu et ille errant,* the German usage may help him to see that *Tu et ille erratis* is paralleled by *Du und er seid im Irrtum.*

It may be of advantage sometimes to call attention to contrasts. Thus after a student has learned in English, Latin, or French that the verb in a relative clause must agree in person with the antecedent of the relative, it may emphasize the German construction to call attention to the contrast.

Du der das gethan *hat.*
Tu qui id *fecisti.*
Tu qui *as* fait cela.
Thou who *hast* done that.

If the student finds difficulty with the accusative and ablative of place in Latin, a reference to the German usage of the dative and accusative may aid him much.

Ich gehe in *die* Stadt.
In *urbem* eo.
Ich bin in *der* Stadt.
In *urbe* sum.

If the student can understand the use of the dative case in such sentences as *Ich wasche mir die Hände,* a hint may set him straight on such expressions as *Se Caesari ad pedes projecerunt.*

The similarity between the Latin and the German with regard to the dative with special verbs has never failed to aid the German or Latin student and particularly in the understanding of the impersonal use of the passive where the analogy is quite close.

Er hat *mir* befohlen das zu thun, *Mihi* imperavit ut id facerem.
Mir ist *von ihm* befohlen worden das zu thun, *Mihi ab eo* imperatum est ut id facerem.

The use of the subjunctive, particularly the Optative Subjunctive, Potential Subjunctive, and Unreal Conditions in Latin and German may also be closely compared.

Comparison between the two languages is possible not only

with regard to constructions but also sometimes in mere phrases and words. For instance, when it has once been brought to the attention of the pupil that the Latin *quo* = *wohin*, and *ubi* = *wo*, he is less liable to say *Ubi is?* or *Quo es*, and possibly also *Wo gehen Sie?* for *Wohin gehen Sie?* or *Wo gehen Sie hin?*

Latin-French

When we consider the relation of French and Latin with regard to constructions and idiom, we find that many of the same opportunities which are present in German are present here also. For example, *laudo* = *Je loue* = *Ich lobe* = *I praise, I am praising, I do praise.* So with the use of the present tense in French, German, and Latin, where the English employs the present perfect.

Je *suis* en Italie depuis deux mois.
Ich *bin* schon zwei Monate in Italien.
Iam duos mensis *sum* in Italia.

The English speaking student is in the habit of using the present tense when he really means the future or even the future perfect. The French and Latin agree in being more exact.

I shall go home when I *do* (or *have done*) this.
J'irai à la maison quand j'*aurai* fait cela.
Domum ibo cum id *fecero.*
Je lui parlerai quand il *viendra.*
Illi dicam cum *veniet.*

If a student of Latin feels tempted to say *Nostros libros habeo* for *Meos libros habeo*, he may be restrained somewhat by his French, *J'ai mes livres*, where his rule tells him that the possessive adjective agrees with the thing possessed in gender and number, but with the possessor in person, and in person only. If the Latin-French student confuses the construction of *Ce livre est à moi* with *Mihi liber est*, the distinction should be made clear to him for the benefit of both languages.

Certain similarities in Latin and French with regard to the subjunctive in subordinate clauses, as after verbs of fearing, commanding, exhorting, doubting, etc., may also be called to the attention of the student with great advantage to both languages.

Ils élurent un roi qui pût la ville défendre.
Regem creaverunt qui urbem defendere posset.

Je ne doute pas qu'il vienne.
Non dubito quin veniat.

Certain phrases and expressions will take on a new meaning for the student if he is once advised of the parallel in the other language. For instance, a student appreciates the meaning of the Latin preposition *apud* much more when once he realizes that it is closely equivalent to the French *chez*. *Chez moi = apud me; Chez les Helvetiens = apud Helvetios.* The French student who may be acquainted with the expression *Il s'agit de votre vie* should be better able to understand the Latin *De tua vita agitur, your life is at stake, it is a question of your life.* Similar examples might be continued almost indefinitely and the points in which parallels are to be found between Latin and French syntax and word usage are almost limitless.

In the study of French for students who have some knowledge of Latin there is a further possibility of correlation in the matter of vocabulary and derivation. How far this should be carried is a rather difficult question. In Switzerland, until recently at least, the study of French derivations was required, and Brachet was in constant use. Such an extreme as this is of course impossible and inadvisable for us, but possibly a few of the simpler and more fundamental principles might be introduced with decided gain. For instance, there is no reason why our French-Latin student should not be expected to know that the French language is a descendant of the Latin, that it is a child not of the classical Latin which he studies but of the vulgar Latin; that a French noun or adjective is derived from the accusative form; that a derived noun will be masculine if the corresponding Latin noun was masculine, or neuter and feminine if the corresponding Latin noun was feminine or a neuter plural. Frequent reference to the Latin word corresponding to the French should be of value to both languages and could be made without much trouble. It might even be advisable to indicate a few of the more im-

portant and simpler transformations which take place in a word which is derived from the Latin. For example that

Latin *a* sometimes becomes *ai* in French.

main—manum; pain—panem; aime—amare, etc.

Latin accented *o* sometimes becomes *eu* in French. Also *œu*.

heure—horam; seul—solum; neuf—novum, etc.

Latin *ct* becomes *it* in French.

fait—factum; lait—lact-; toit—tectum; fruit—fructum.

French sometimes adds *e* to initial *s*.

esprit—spiritum; espérer—sperare: école—scholam.

Perhaps other elementary principles might be introduced as they are found classified and grouped in Brachet, *Grammaire de la Langue Française;* Zauner, *Romanische Sprachwissenschaft;* Sudre, *Formation des Mots et Vie des Mots;* Carré, *Mots dérivés du Latin et du Grec;* Brunot, *Grammaire Historique de la Langue Française;* Nyrop, *Grammaire Historique de la Langue Française.*

French and German

The points of contact in correlating French and German are mainly syntactical and here many parallels of expression and construction are to be found as a basis for employing a knowledge of one language to illustrate and explain the other. One of the first principles of either French or German which offers difficulty is the use of the auxiliary *être* in French and *sein* in German. If the student is shown that *Je suis allé* and *Ich bin gegangen* are parallel uses, he may be less liable to follow the English idiom and say *J'ai allé* or *Ich habe gegangen.* Of course care must be taken to show where the French and German idioms differ in this, particularly with regard to the use of *être* as the auxiliary with reflexives where the German employs *haben.*

Again the fact that the English passive is frequently replaced by a construction with *man* in German will be emphasized by calling attention to the use of *on* in French.

I have been told that this is true.
Man hat mir gesagt dass das wahr ist.
On m'a dit que cela est vrai.

Consider also the common gain for French and German when the student appreciates the similarity of idiom in such examples as the following:

Ich wasche *mir die* Hände.
Je *me* lave *les* mains.

Er schüttelte *den* Kopf.
Il secoua *la* tête.

Er drehte *sich* um.
Il *se* retourna.

Die Tür öffnete *sich*.
La porte *s'*ouvrit.

Was *hast* du gestern *gethan?*
Qu'est-ce que tu *as fait* hier?

Such parallels as these abound, and every page of French or German offers opportunity for a beneficial correlation of the two languages.

In citing the above examples illustrating the close parallels existing between the various languages, the aim, as before stated, has been not to exhaust the subject, but merely to point out a few instances to indicate the rich possibilities for correlation and coöperation in language teaching. Personally the writer is conscious of having on many occasions treated the matter in a rather desultory fashion, employing the idioms of French, German or Greek to illustrate a point as it happened to come up, without any definite plan, and sometimes, as he has found to his sorrow, without sufficient knowledge. The purpose of this paper, then, is not to call attention to that which is already obvious, nor to urge what is already in practice, but to recommend a more careful survey of the field and the adoption of a definite scheme for coöperation in this direction. Yet in this, as in all other things, the "golden mean" must be preserved. Any attempt to carry this theory to extremes and to try to find a parallel for every minute point would only become cumbersome and defeat the very object aimed at. Care should be taken to try to illustrate

only that which requires illustration and to parallel a given construction only where the comparison will throw some light on one or both of the languages concerned.

English

It remains, perhaps, to call attention to some phases of the relation of English to the other languages taught in our schools. It is, of course, needless to call attention to the value which the study of any foreign language can give to our own, nor is it necessary to emphasize the importance of insisting on an idiomatic rendering in translation. In one or two aspects, however, the relation of English to the foreign languages deserves our attention.

There seems to be a tendency among the latest grammarians of English to cut loose from the strict, old-time terminology and the earlier practice in the explanation of constructions. If we are to consider the English language by itself and without reference to other languages, many of the changes may seem advisable, or, at least, harmless. But many of these changes work considerable hardship for the student and teacher of other languages. The two following illustrations are taken from a well-known English Grammar, where some rather startling usages are sanctioned. "'It is me,'" says the author, "has become a stereotyped, idiomatic, colloquial, expression used without hesitation by the mass of the people and shunned only by the fastidious." Most of us, I imagine, will be perfectly willing that the author should say "It is me," if it suits his views, but we may well object to having our students taught to ignore the formal basis of language to such an extent that we are left no foundation on which to build another language. Again this same author says, "In colloquial English, however, 'Who did you see?' has long been a common usage, and can scarcely be regarded as incorrect." Yet the sanction of such a usage is bound to cause considerable trouble to the student of a foreign language.

It is rather inconsistent for the English grammarian to insist on the derivative force of the genitive case in "my" and "our"

from "min" and "eower" and then to justify "I" as a true nominative in the sentence *I was given a book* where historical grammar shows the "I" to stand for the dative "me." To carp at such inconsistencies would, perhaps, be rather pedantic if we were to consider the English grammar in isolation, but in sanctioning such bad grammar in English the grammarian works great damage and causes great difficulty for the teacher of any other language. For instance, it is no easy task to teach the student of Latin that he must not follow the English idiom and say (*Ego*) *librum datus sum*, and when the English speaks of the "retained object" *book*, it is very difficult to teach the student of Latin to say *Mihi liber datus est.*

A second point which demands attention in considering the correlation of English and any foreign language is the possibility of coöperation in English composition work. Here we find two possibilities, one in theme writing and the other in translation. There are surely occasions when there would be advantage to two departments in a theme written on such a subject as "The Life of Cæsar," on "The Catilinarian Conspiracy," on the subject matter of *Das Edle Blut* or *Le Curé de Tours*, or any one of a multitude of subjects. Such a theme could be read for content by the teacher of French, German, Latin, or Greek, and for style and grammar by the teacher of English.

Likewise written translations could be examined by the teacher of the foreign language and by the teacher of English with advantage to both.

The essential matter of the latter part of this paper may be summed up in the following recommendation for a working scheme: That all the teachers of language in a given school unite in the endeavor to correlate the various languages taught in the school; first, by determining upon a uniform and consistent terminology; secondly, by drawing up a definite scheme of the various points of contact between the different languages upon which emphasis should be placed.

EQUIPMENT FOR TEACHING OF DOMESTIC SCIENCE

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WITH A CHAPTER ON

THE SCHOOL OF HOUSEHOLD ARTS

TEACHERS COLLEGE, COLUMBIA UNIVERSITY

By BENJAMIN R. ANDREWS

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PREFACE

The purpose of this pamphlet is to discuss the problems that are met in planning a domestic science equipment, to suggest practical solutions that have been worked out through experience, and to give a description of what is done in some of the schools and colleges of this country. As this is not a statistical report, space allows only a few schools and colleges to be mentioned.

Thanks are due to the teachers, superintendents and supervisors who have kindly given informaton and whose institutions are mentioned in these pages; to the members of the domestic science staff of Teachers College; and to those students in the Department of Domestic Science at Teachers College who have collected data from year to year. It has not been possible to publish all the information that has been so kindly furnished.

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